Anthony Langford 1827

THE

AMERICAN ARITHMETIC,

ADAPTED TO THE

Currency of the United States.

TO WHICH IS ADDED A CONCISE TREATISE ON THE

MENSURATION OF PLANES AND SOLIDS.

COMPILED FOR THE USE OF SCHOOLS, &c.

BY OLIVER WELCH.

Fifth Edition.

EXETER:

PRINTED AND PUBLISHED BY GERRISH & TYLER, AND FOR SALE BY THEM WHOLESALE AND RETAIL;—SOLD ALSO BY THE PRINCIPAL BOOK SELLERS IN NEW-ENGLAND.

1826.

PREFACE

TO THE FIFTH EDITION OF

WELCH'S AMERICAN ARITHMETIC.

TAKING into consideration the difficulties generally attending the introduction of any new school book to general use, and the encouragement which this system of Arithmetic has met with, since its first publication, the Author feels more confident than ever that a system like this was wanted, and will receive the approbation of the public; if a quick and continued sale of a book are recommendations in its favour, this system of Arithmetic may claim a competent share of them; it was at first offered to the public without any recommendations but its own merits, and three thousand copies of the first, four thousand of the second, four thousand of the third and six thousand of the fourth edition have been published and sold since the year 1813, and the present demand increasing. These are the only recommendations that will be offered in this edition: anxious to promote the usefulness of this work, the Author has expunged whatever was deemed exceptionable in former editions, and added things more useful; correspondents have been consulted, and in conformity to their opinions a few questions in Lawful Money

in several rules have been inserted; and the Decimal Tables of Weights and Measures, and the Tables of the Monies of the World have been expunged, and a short and easy system of Book-keeping, suitable for the Farmer, the Mechanic, and Trader, have been inserted in their stead; the rest of the work in this edition is similar to the third edition, excepting a few errors have been corrected: And while the Author acknowledges his grateful thanks to the public for the kind reception of the former editions of this work, he solicits a continuance of their favours, and flatters himself that this edition will be received with an increased confidence in the merits of the work.

THE AUTHOR.

THE

AMERICAN ARITHMETIC,

AND

PRACTICAL MENSURATOR.

ARITHMETIC is the art of computing by numbers; these numbers are called Figures, *viz.* 0, 1, 2, 3, 4, 5, 6, 7, 8, 9,—0, of itself has no value, but when joined to the right of other numbers, it increases their value in a tenfold proportion. Thus, 1 is one, 10 is ten, 2 is two, 20 is twenty.

Of other Characters used in Arithmetic.

This mark + Is the sign of Addition; and shews, that the number which follows the sign, must be added to the number before it. Thus 9 + 10 signifies that 9 and 10 are to be added.

" — Is the sign of subtraction; and denotes the number following it, must be subtracted from the one before it. Thus, 16—4 signifies that 4 must be taken from 16.

" × Is the sign of Multiplication; and denotes that all the numbers, between which it is placed, are to be multiplied together. Thus, 9×9 signifies that 9 is to be multiplied by 9, or 9×9×9 must be multiplied.

" ÷ Is the sign of Division; and denotes the number standing before it, is to be divided by the number following it. Thus, 9÷3 signifies that 9 is to be divided by 3.

" = This is the sign of equality, and signifies the sum or product of the numbers, before it, is equal to the number after it, 2+4+5=11, mean that 2, 4 and 5 added, their sum would be 11; and 2×4×5=40,

mean that 2 and 4 multiplied, and that product multiplied again by 5, the product is equal to 40; and also $9 \times 8 \div 12 = 6$, means that 9 and 8 multiplied, and the product divided by 12, the quotient will be equal to 6.

„ : : : : Are the signs of proportion, as 7 : 14 : : 8 : 16, and are read as 7 to 14, so is 8 to 16.

„ $\sqrt[2]{}$ This shews the Square Root of the number is required.

„ $\sqrt[3]{}$ This shews the Cube Root of the number is required.

Numeration Table.

Millions of Millions.	Hundreds of Thous. of Millions.	Tens of Thousands of Millions.	Thousands of Millions.	Hundreds of Millions.	Tens of Millions.	Millions.	Hundreds of Thousands.	Tens of Thousands.	Thousands.	Hundreds.	Tens.	Units.
1	2	3	4	5	6	7	8	9	4	3	2	3
	2	3	4	5	6	7	8	9	4	3	2	3
		3	4	5	6	7	8	9	4	3	2	3
			4	5	6	7	8	9	4	3	2	3
				5	6	7	8	9	4	3	2	3
					6	7	8	9	4	3	2	3
						7	8	9	4	3	2	3
							8	9	4	3	2	3
								9	4	3	2	3
									4	3	2	3
										3	2	3
											2	3
												3

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	1
2	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	2
3	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	3
4	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	4
5	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	5
6	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	6
7	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	7
8	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	8
9	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	9
10	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	10

The use of this Table in Addition.

Look for the number to be added on the left or right hand, and the number with which you would add it on the top, and in the corner, or angle in which the lines meet, stands the sum required.—It is required to add 7 with 13, look for 7 on the left, or right, and move along on that line till 13 on the top stands directly over, and in the angle of the two lines stands 20, the sum required.

The use of this Table in Subtraction.

Look for the number to be subtracted on the left or right hand column, and on that line look along towards the right or left hand, till you find the number from which you would subtract, and directly over that number on the top, is a number answering to the remainder.

EXAMPLE.

Required to take 9 from 15, look for 9 on the left or right hand, then follow that line towards the right or left till you find 15, and on the top directly over 15 is 6, the remainder required.

SIMPLE ADDITION.

DEFINITION.—Simple Addition teaches to add together several sums of the same denomination.

RULE.—Set down units under units, tens under tens, and hundreds under hundreds, &c. Begin to add in the place of units, add all in that column, carry one for every ten that is in the sum of units, to the place of tens, and set down all that is over ten, or tens; add up the column of tens, carry one for every ten to the next column, and set down all that is over; thus proceed through all the columns to the last: observe to set down the whole sum in the last column.

PROOF. Begin at the top, add downwards, carry as before, and if the work is right, the sum will be the same as it was when added upwards.

EXAMPLES.

123456	34564	98764321	64321
654321	32567	12345678	4321
123456	37432	82456781	5432
654321	12345	94321452	432
1555554	116908	287888232	74506

Practical Questions in Addition.

1. Add together 345674, 98736, 456752 and 7654.
Ans. 908816.
2. Add 94321, 675431, 1234 and 76432 together.
Ans. 847418.
3. Add 6421, 94742, 6752 and 875432 together.
Ans. 983347.
4. Add 67432, 98891, 65641 and 77421 together.
Ans. 309385.
5. Add 9944, 2343, 78764 and 94929 together.
Ans. 185980.

6. I lent a friend 942 dollars, at one time, at another 741, at another 91 ; what is the whole sum lent?

Ans. 1774 dolls.

7. A man killed 4 hogs, weighing as follows; one 396, one 472, one 510 and one 371 ; what did they all weigh?

Ans. 1749.

8. I killed an ox, his quarters weighed 642, his hide 105, his tallow 92 ; what did they all weigh?

Ans. 839.

9. A man gave to three sons as follows, to one 3427 dolls. to another 3025 dolls. to another 2947 dolls. what did he give to all of them? Ans. 9399.

10. A man's taxes were as follows for three years ; the first 142 dolls. second 165, the third 210 dolls ; what did he pay in three years? Ans. 517.

SIMPLE SUBTRACTION.

Definition.—Simple Subtraction teaches to take a less number from a greater, that is of the same denomination, and thereby find the difference, or remainder.

Rule.—Write the largest number down first ; and the smallest underneath, units under units, &c. begin to subtract in the place of units ; and take the under from the upper figure ; set down the remainder: If at any time any particular figure in the lower line is larger than the one immediately over it, subtract the under figure from ten ; to the remainder add the upper figure and set it down ; and carry one to the next figure in the lower line ; thus proceed through the whole.

Proof.—Add the remainder and the lower line together, and if the work is right the sum will be like the upper line.

EXAMPLES.

From	245678	456789	784567	943213456
Take	136789	217894	659432	744321234
Rem.	108889	238895	125135	198892222

Practical Questions in Subtraction.

1. What is the difference between 24567 and 7456?
Ans. 17111.

2. I lent a friend 2456 dollars and received in part 1342 dollars; what remains due? Ans. 1114 dolls.

3. A merchant owes 34323 dollars his effects are worth but 22749 dollars; how much will he fall in debt?
Ans. 11574 dolls.

4. A merchant has an estate in his hands valued at 52394 dolls. he owes 31399 dollars; what is he worth after paying his debts? Ans. 20995 dolls.

5. A merchant sent a ship and cargo to sea valued at 11497 dollars and on her return, she and her cargo was valued at 16579 dolls; what was his gain?
Ans. 5082 dolls.

6. A ship builder built a ship, which cost him 6241 dolls, and he sold her for 5927 dolls.; what did he lose?
Ans. 314 dolls.

7. A. borrowed of B. 9427 dolls. and he paid him at one time 4249 dolls. at another time 1427 dolls. and at another time 947 dolls.; what remains due?
Ans. 2804 dolls.

SIMPLE MULTIPLICATION.

Definition.—Simple Multiplication is a compendious way of adding; as 9 multiplied by 6 is equal to 54, and is the same as if 9 were set down 6 times and added up.

The number to be multiplied is called the multiplicand.

The number given to multiply by, is called the multiplier.*

The number arising from the operation is called the product.

The following table must be committed to memory before any progress can be made in Multiplication.

*The multiplicand and multiplier are in general terms called Factors.

Multiplication Table.

1	2	3	4	5	6	7	8	9	10	11	12
2	4	6	8	10	12	14	16	18	20	22	24
3	6	9	12	15	18	21	24	27	30	33	36
4	8	12	16	20	24	28	32	36	40	44	48
5	10	15	20	25	30	35	40	45	50	55	60
6	12	18	24	30	36	42	48	54	60	66	72
7	14	21	28	35	42	49	56	63	70	77	84
8	16	24	32	40	48	56	64	72	80	88	96
9	18	27	36	45	54	63	72	81	90	99	108
10	20	30	40	50	60	70	80	90	100	110	120
11	22	33	44	55	66	77	88	99	110	121	132
12	24	36	48	60	72	84	96	108	120	132	144

CASE I.

When the multiplier is a single figure.

Rule.—Under the multiplicand write down the multiplier, in the place of units; draw a line underneath, and multiply every figure of the multiplicand, by the multiplier; observing to carry one for every ten to the next product. The whole product of the last figure multiplied, must be set down.

EXAMPLES.

64324	68459	646246
6	8	9
385944		

Proof.—Cast the nines from the multiplicand; and all that is over put at the right of a cross, (which is made thus ×); then cast the nines from the multiplier, and all that is over, put at the left of the cross; then cast the nines from the product, and put all that is over at the top of the cross. Then multiply the figure on the left of the cross with the one on the right; cast the 9's from the product, and what is over, put at the bottom of the cross;

and if the top and bottom figures are alike, the work is right.

NOTE.—The preceding method of proof is liable to one error, viz, if any of the figures in the product should happen to be transposed, as if 468 in the product should happen to be written 648, the work would prove, and an error would still exist.

Second method of Proof.—Divide the product by the multiplier, and if the work is right the quotient will be like the multiplicand. This method can be used only by those who have attained to a knowledge of division.

CASE II.

When the multiplier consists of several figures.

RULE.—Set down the multiplier under the multiplicand, units under units, &c. multiply each figure in the multiplier into every figure in the multiplicand, singly, as in case first, observing to set down the first figure of the product exactly under the figure by which you are multiplying; then add the several products together, their sum will be the product required.

EXAMPLES.

	Proof.		*Proof.*
74326	8	12764	0
246	3×4	342	0×2
	8		0
445956		25528	
297304		51056	
148652		38292	
	8		0
18284196 product.		4365288 product.	

Questions.

No.	*Multiplicands.*			*Multipliers.*		*Products.*
1.	24567	×	by	123	=	3021741
2.	12434	×	by	432	=	5371488
3.	12345	×	by	246	=	3036870
4.	45678	×	by	333	=	15210774
5.	23243	×	by	2002	=	46532486
6.	34567	×	by	4001	=	138302567
7.	23456	×	by	1003	=	23526368
8.	90042	×	by	9009	=	811188378
9.	701231	×	by	1231	=	863215361

CASE III.

When there are cyphers at the right hand of the multiplicand, or multiplier, or both.

Rule.—Multiply by the figures only; and to the right of the product annex as many cyphers, as are equal to the number of cyphers in both factors.

EXAMPLES.

	101200	456000	94000
	200	3000	20
Products.	20240000	1368000000	1880000

Questions.

No.	Multiplicands.			Multipliers.		Products.
1.	621000	×	by	2900	=	1800900000
2.	700000	×	by	9900	=	6930000000
3.	854000	×	by	7600	=	6490400000
4.	943200	×	by	7000	=	6602400000
5.	94944	×	by	600	=	56966400
6.	412342	×	by	550	=	226788100
7.	671230	×	by	123	=	82561290
8.	421233	×	by	120	=	50547960
9.	4567852	×	by	9000	=	41110668000

Practical Questions in Multiplication.

1. A man had a farm on which he raised 360 bushels of wheat; and he had another, on which he raised 6 times as much; what quantity did he raise on both of them? Ans. 2520 bushels.

2. A man had an estate which he divided among 9 sons as follows, *viz.* to the first eight, he gave 333 dollars each; to the ninth, he gave as much wanting 1000 dollars as to the other eight; I demand the value of the estate; and also the ninth son's share.

Value of the estate 4328 dolls.
The 9th son's share 1664 dolls.

3. A man sheared 364 sheep, six years successively, each sheep neated 3 pounds of wool per year: how much wool had he yearly; and how much in six years?

Ans. Yearly 1092 pounds.
In six years 6552 pounds.

4. I sold 342 tons of iron at 142 dollars per ton: I demand the price of the whole. Ans. 48564 dolls.

5. I sold 742 thousand of boards in the W. I. at 62 dollars per thousand; what did they come to?

Ans. 46004 dolls.

6. What will 6422 quintals of fish come to at 6 dolls. per quintal? Ans. 38532 dolls.

7. A man travelled 26 days, and each day he travelled 47 miles; what distance did he travel in the whole time? Ans. 962 miles.

SIMPLE DIVISION.

Definition.—Simple Division teaches to find how many times a smaller number is contained in a larger.

The number given to be divided, is called the dividend.

The number given to divide by, is called the divisor.

That number which expresses the number of times that the divisor is contained in the dividend, is called the quotient, or answer.

If any thing is left after dividing, it is called the remainder.

LONG DIVISION.

Long Division is when the Divisor is more than twelve.

CASE I.

Rule.—Write down the dividend, on the right and left draw a curved line; on the left hand of the dividend write down the divisor; seek how many times the divisor can be had in a competent number of the first figures of the dividend, and place the figure expressing the number of times at the right of the dividend; multiply the divisor by the same figure, and place the product under the first figures of the dividend, and subtract; to the re-

mainder bring down the next figure of the dividend, and divide as before; and thus proceed until all the figures of the dividend are brought down; if at any time when you have brought down a figure the sum is still less than the divisor, a cypher must be placed in the quotient, and another figure must be brought down; the remainder must always be less than the divisor.

Proof.—Multiply the quotient and divisor together, to the product add the remainder (if there is any) and the sum will be like the dividend, if the work is right.

EXAMPLES.

```
        Dividend.                         Dividend.
Div.16)3721491(232593 Quo.   Div.24)3102134(129255 Quo.
       32                           24
       --                           --
        52                           70
        48                           48
        --                           --
         41                           222
         32                           216
         --                           ---
          94                            61
          80                            48
          --                            --
          149                            133
          144                            120
          ---                            ---
            51                            134
            48                            120
            --                            ---
             3 Rem.                        14 Rem.
```

Questions.

No.	Dividends.		Divisors.		Quotients.	Rem.
1.	1432400	÷	222	=	6452	56
2.	2045600	÷	912	=	2242	896
3.	9400032	÷	203	=	46305	117
4.	9320143	÷	4211	=	2213	1200
5.	7345681	÷	5566	=	1319	4127
6.	5432140	÷	2345	=	2316	1120
	6041231	÷	9760	=	618	9551

CASE II.

When there are cyphers at the right of the divisor.

RULE.—Cut off the cyphers, and also cut off as many figures, or cyphers from the right of the dividend; divide the remaining part of the dividend as before, and to the right of the remainder, place the figures which were cut off from the dividend.

EXAMPLES.

1. Divide 5642321 by 432000.

```
432|000)5642|321(13 Quo.
        432
        ----
        1322
        1296
        --------
          26321 Rem.
```

No.	Dividends.		Divisors.			
2.	764213	÷	12000	=	*Ans.*	$63\frac{8213}{12000}$
3.	943217	÷	5000	=	*Ans.*	$188\frac{3217}{5000}$
4.	674321	÷	11200	=	*Ans.*	$60\frac{2321}{11200}$
5.	432132	÷	9200	=	*Ans.*	$46\frac{8932}{9200}$

NOTE.—To divide by 10, 100, or 1000, &c. is only to cut off as many figures, or cyphers from the right of the dividend as are equal to the number of cyphers on the right of the divisor.

Practical Questions in Division.

1. A man had an estate valued at 2474 dolls. and it was divided equally between twelve sons: I demand the share of each. Ans. $\$206\frac{2}{12}$

2. If a tax of 40000 dollars were to be levied upon 1200 polls; I demand what one poll would pay.
Ans. $\$33\frac{400}{1200}$

4. Divide 1474 dollars equally among 25 men, 30 women, 17 boys, and 27 girls; after taking out 75 dollars for a present to a nephew. Ans. $\$14\frac{13}{99}$

4. Divide 247600 pounds of beef equally among an army of 23724 men. Ans. $10 \frac{10360}{23724}$ lbs.

5. Sixty men at a feast, which lasted 3 days, spent 240 dollars per day; how much did each man spend per day, and how much in the whole?

Ans. $4 per day, and $12 the whole.

6. Divide 151200 lbs. of beef equally among an army consisting of 27 regiments, each regiment 7 companies, and each company 100 men.

Ans. 8 lbs.

7. If 10500 dollars are given for 750 barrels of flour; I demand the price of one barrel.

Ans. $14.

8. If 45 horses were sold in the West-Indies for 9900 dollars, I demand the average price.

Ans. $220 each.

SHORT DIVISION.

Short Division is when the divisor is less than 12.

RULE.—Seek how many times the divisor is contained in a competent number of the figures on the left hand of the dividend, and set the figure expressing that number underneath, and all that is over call so many tens, annex the next figure of the dividend to the tens, divide as at first; and thus proceed through the whole, and the quotient will stand under the dividend.

EXAMPLES.

2)423(	3)4567(	4)61234(	5)1234567(
$211\frac{1}{2}$ Ans.	$1522\frac{1}{3}$ Ans.	$15308\frac{2}{4}$ Ans.	$246913\frac{2}{5}$ Ans.
6)64567(	7)12345(	8)43213(	9)764321(

COMPOUND ADDITION.

DEFINITION.—Compound Addition teaches to add different denominations together; such as dollars, cents and mills. Tons, hundreds, quarters, pounds, &c.

RULE.—Write down dollars under dollars; cents under cents; mills under mills. Tons under tons; hundreds under hundreds; pounds under pounds, &c. always observing to write every denomination under that of the same name; begin to add in the lowest denomination mentioned; find the sum of that denomination; divide the sum by the number which it takes of this denomination, to make one of the next higher; set down the remainder, and carry the quotient to the next denomination; find the sum of the next, and proceed as before through all the denominations; observing to set down the whole sum of the last denomination.

AMERICAN, OR FEDERAL MONEY.

10 Mills	make	1 Cent.	Marked	*m*. *c*. or *cts*.
10 Cents	"	1 Dime.	"	*d*.
10 Dimes	"	1 Dollar.	"	*D*. or $
100 Cents	"	1 Dollar.	"	*D*. or $
10 Dollars	"	1 Eagle.	"	*E*.

EXAMPLES.

E.	*D*.	*cts*.	*m*.	*E*.	*d*.	*cts*.	*m*.	*D*.	*cts*.	*m*.
126	8	76	4	1234	4	43	6	4567	19	8
21	4	32	1	321	3	46	5	4347	86	7
2	3	45	6	464	5	43	2	7451	75	6
22	4	32	4	364	6	34	1	3321	99	4
173	0	86	6	2384	9	67	4	19689	41	5*

*Some have objected to having the answers put to these questions; but the author is of opinion that they can do no harm, but will abundantly facilitate the labour of the instructor; if the scholar should attempt to copy without adding up the columns, the book can be taken from him; and if he does copy the two or three first questions, it will be impossible to copy the practical questions.

Practical Questions in Money.

1. Add together $21,71 cts.; $63,42 cts. $84,96 cts.
Ans. $170,09 cts.

2. A. owes me $91,64 cts. 7 m.; B. $102,75 cts.; and C. $21,42 cts.; what do they all owe me?
Ans. $215,81 cts. 7 m.

3. A. owes B. $91,73 cts.; C. $112,41 cts.; and D. $119,91 cts.: I demand what he owes to B. C. & D.
Ans. $324,05 cts.

4. A. has a demand upon B. for $642,20 cts.: upon C. for $219; and upon D. $750,94 cts.; I demand the sum of all his debts? Ans. $1612,14 cts.

5. A farmer sold 3 yoke of oxen; for one yoke he received $105; one $117,75 cts.; and one $95,55 cts.; what did they all come to? Ans. $318,30 cts.

6 What is the value of 3 ships, apprized as follows, viz, one at $4750; one at $6742; and one at $7891?
Ans. $19383.

Lawful Money.

Formerly the money of account of the United States was pounds, shillings, pence and farthings: in the first and second editions of this work, I neglected that method of reckoning altogether, excepting in exchange, and it is my opinion still that the knowledge of lawful money ought to be obliterated entirely from our schools: but the tide of publick opinion in many sections of the country is so strong in favour of keeping up that method of reckoning, that I have added a few questions in each rule in that currency for the gratification of those who wish to keep up that method of reckoning; those who do not think it of any consequence, can neglect that part and attend to the Federal Currency altogether.

Lawful Money.

4 farthings	make	1 penny	marked	qr. d.
12 pence		1 shilling		s.
20 shillings		1 pound		£*

*The value of a pound is different in different States, (See exchange,) but in all the New-England States it is the same.

EXAMPLES.

£.	s.	d.	£.	s.	d.
123	19	10¼	462	17	6½
233	12	4¾	143	15	7¼
96	16	7½	211	11	6¾
12	11	6¼	19	11	4¼
467	0	4¾	837	16	0¾

Practical Questions.

1. A merchant has due from one man, £.241 12s. 9½d.; from another £241 17s. 6d.; from another £211 19s. 6d. what is due from them all? Ans. £695 9s. 9½d.

TROY WEIGHT.

By this weight is weighed gold, silver, &c.

24	Grains	make 1	Pennyweight	marked	*gr. pwt.*
20	Pennyweights	1	Ounce	"	*oz.*
12	Ounces	1	Pound	"	*lb.*

EXAMPLES.

lb.	*oz.*	*pwt.*	*gr.*	*lb.*	*oz.*	*pwt.*	*gr.*
245	10	19	23	2345	11	19	23
146	11	16	20	123	7	8	9
145	2	0	7	34	5	16	17
538	0	17	2	2504	1	5	1

Practical Questions in Troy Weight.

1. A man has two wedges of gold, one weighing 25 lb. 3 oz. 12 pwt. and the other weighing 1 lb. 11 oz. 12 pwt. 7 gr.; I demand the weight of the two wedges.
Ans. 27 lb. 3 oz. 4 pwt. 7 gr.

2. What is the weight of the following silver articles, viz. one spoon weighing 1 lb. 10 oz. 19 pwt.; one tankard weighing 4 lb. 6 oz.; one basin weighing 1 lb. 10 oz. 19 pwt.? Ans. 8 lb. 3 oz. 18 pwt.

Avoirdupois Weight.

By this weight is weighed sugar, iron, steel, dye woods, and all drossy metals; hay, flour, and many other articles of trade.

16 Drams	make	1	Ounce.	marked	*dr.*	*oz.*
16 Ounces	"	1	Pound.	"		*lb.*
28 Pounds	"	1	Quarter.	"		*qr.*
4 Quarters	"	1	Hundred.	"		*cwt.*
20 Cwt.	"	1	Ton.	"		*ton.*

EXAMPLES.

Tons.	*cwt.*	*qr.*	*lb.*	*oz.*	*dr.*	*Tons.*	*cwt.*	*qr.*	*lb.*	*oz.*	*dr.*
444	12	1	12	2	13	123	12	2	22	10	12
41	11	0	10	12	13	321	19	3	27	15	15
123	19	3	12	15	15	141	12	2	19	11	12
610	3	1	7	15	9	587	5	1	14	6	7

Practical Questions in Avoirdupois Weight.

1. Add together the following parcels, viz. 12 cwt. 2 qr. 17 lb.; 1 ton, 19 cwt. 3 qr. 27 lb. 15 oz. 15 dr.; and 2 tons, 12 cwt. 2 qr. 20 lb. 12 oz. 10 dr.

Ans. 5 tons, 5 cwt. 1 qr. 9 lb. 12 oz. 9 dr.

2. What is the weight of 3 hhds. of sugar, weighing as follows, viz. 1st, 9 cwt. 3 qr. 12 lb.; the 2d, 10 cwt. 1 qr. and 12 lb.; and the 3d, 8 cwt. 3 qr. 27 lb.?

Ans. 29 cwt. 0 qr. 23 lb.

Apothecaries' Weight.

By this weight is weighed Medicine, &c.

20 Grains	make	1	Scruple	marked	*gr.*	*sc.*
3 Scruples	"	1	Dram	"		*dr.*
8 Drams	"	1	Ounce	"		*oz.*
12 Ounces	"	1	Pound	"		*lb.*

EXAMPLES.

lb.	oz.	dr.	sc.	gr.
23	6	7	2	19
10	5	4	1	10
11	0	3	2	11
45	1	0	1	0

lb.	oz.	dr.	sc.	gr.
121	11	7	2	19
911	2	6	1	11
191	1	4	1	9
1224	4	2	2	19

Practical Questions, in Apothecaries' Weight.

1. Add together 22 lb. 0 oz. 1 dr. 2 sc. 13 gr.; 12 lb. 0 oz. 6 dr. 2 sc. 19 gr.; and 22 lb. 1 dr. 1 sc. 19 gr.
Ans. 56 lb. 1 oz. 2 dr. 1 sc. 11 gr.

2. Add together 11 lb. 11 oz. 6 dr. 2 sc. 12 gr.; 21 lb. 6 oz. 6 dr.; and 122 lb. 9 oz. 2 dr. 1 sc. 10 gr.
Ans. 156 lb. 3 oz. 7 dr. 1 sc. 2 gr.

Long Measure.

By this measure is measured distances; and by some it is called running measure.

3	Barley Corns	make	1 Inch.	marked	*in.*
12	Inches	"	1 Foot.	"	*ft.*
3	Feet	"	1 Yard.	"	*yd.*
5½	Yards	"	1 Rod.	"	*rd.*
16½	Feet	"	1 Rod.	"	*rd.*
40	Rods	"	1 Furlong.	"	*fur.*
8	Furlongs	"	1 Mile.	"	*M.*
3	Miles	"	1 League.	"	*lea.*
60	Geographical or	}	1 Degree of the Earth's		
69½	Statute Miles	}	great circle.		*deg.*
360	Degrees	"	1 Circle.	"	*cir.*

(*bar.* is printed as the abbreviation for Barley Corns.)

EXAMPLES.

Deg.	St. m.	fur.	rd.	ft.	in.	bar.
122	68	6	30	15	10	2
211	10	4	20	15	9	1
31	6	2	39	14	2	2
21	37	3	4	12	1	2
386	53½	1	16	8½	0	1

Miles.	fur.	rd.	yd.	ft.
240	7	39	4	2
213	6	11	2	1
12	4	31	2	2
144	2	22	4	1
611	5	25	3	0

Practical Questions in Long Measure.

1. The distance from A to B, is 3 miles 6 fur. 27 rods; from B to C, is 1 lea. 2 miles, 7 fur.; from C to D, 27 lea. 1 mile, 2 fur. 39 rods; I demand the distance from A to D. Ans. 30 lea. 2 mi. 0 fur. 26 rods.

2. A ship sailed south 6 lea. 1 mile; S. S. E. 9 lea. 2 miles 0 fur. 39 rds.; E. S. E. 21 lea. 1 mile 6 fur. 7 rds.; what was the whole distance sailed?

Ans. 37 lea. 1 mile. 7 fur. 6 rds.

LAND OR SQUARE MEASURE.

This measure is used in measuring all things that have length and breadth without regard to thickness.

144	Inches	make	1	Foot.	marked	*in. ft.*
9	Feet	"	1	Yard.	"	*yd.*
30¼	Yards	"	1	Rod.	"	*rd.*
272¼	Feet	"	1	Rod.	"	*rd.*
40	Rods	"	1	Rood.	"	*rood.*
4	Roods	"	1	Acre.	"	*acre.*
160	Rods	"	1	Acre.	"	*acre.*

EXAMPLES.

Acres.	*roods.*	*rds.*	*ft.*	*in.*
272	3	39	216	123
142	2	26	270	143
123	1	10	16	43
321	0	7	8	139
860	0	3	240¾	16

Acres.	*roods*	*rds.*
212	2	29
148	2	29
143	2	10
341	3	39
846	3	27

Practical Questions in Land, or Square Measure.

1. A man had several lots of land; the 1st, contained 27 acres 3 roods; the 2d, 19 acres, 2 roods, 27 rods, 17 feet; and the 3d, 6 acres, 2 roods, 39 rods: I demand the quantity in the 3 lots.

Ans. 54 acres, 26 rods, 17 feet.

2. Add together 64 acres, 2 roods, 39 rods; 61 acres, 3 roods, 17 rods; and 104 acres, 2 roods, 22 rods.

Ans. 231 acres, 0 roods, 38 rods.

Wine Measure.

By this measure, are measured wine, rum, gin, and almost every thing that is sold by the gallon, &c. A gallon wine measure is equal to 231 solid, or cubic inches.

4 Gills	make	1 Pint.	marked	*gil.*	*pt.*
2 Pints	"	1 Quart.	"		*qt.*
4 Quarts	"	1 Gallon.	"		*gal.*
42 Gallons	"	1 Tierce.	"		*tier.*
63 Gallons	"	1 Hogshead.	"		*hhd.*
84 Gallons	"	1 Puncheon.	"		*pun.*
126 Gallons or 2 hhds.		1 Pipe.	"		*pipe.*
2 Pipes, or 252 gal.		1 Tun.	"		*tun.*

EXAMPLES.

Pun.	*gal.*	*qt.*	*pt.*
143212	38	3	1
43200	71	1	0
32111	21	2	1
272	10	1	0
218796	58	0	0

Pipes.	*hhd.*	*gal.*	*qt.*	*pt.*
123	1	62	3	1
43	1	41	2	0
4	0	21	1	1
8	1	17	3	0
175	1	17	2	0

Practical Questions in Wine Measure.

1. What is the sum of the following parcels, viz. 19 gal. 2 qt. 1 pt.; 12 gal.; 1 qt.; 21 gal. 3 qt.; and 1 hhd. 3 gal.? Ans. 1 hhd. 56 gal. 2 qt. 1 pt.

2. A merchant received from Lisbon at one time 123 pip. 1 hhd. 62 gal. 3 qts. 1 pt.; at another time 43 pip. 1 hhd. 41 gal. 2 qts.; and at another time he received 4 pip. 40 gal.; what did he receive in all? Ans. 172 pip. 18 gal. 1 qt. 1 pt.

Ale and Beer Measure.

By this measure is bought and sold beer, milk, &c. one ale or beer gallon contains 282 S. inches.

2 Pints	make	1 Quart.	marked	*pt. qt.*
4 Quarts	"	1 Gallon.	"	*gal.*
8 Gallons	"	1 Firkin Ale.	"	*A. fir.*
9 Gallons	"	1 Firkin Beer.	"	*B. fir.*
36 Gallons	"	1 Barrel.	"	*bbr.*
1½bbr.or.54G.	"	1 hhd.	"	*hhd.*
3 Barrels	"	1 Butt.	"	*butt.*

EXAMPLES.

Hhd.	*gal.*	*qt.*	*pt.*		*Bbr.*	*gal.*	*qt.*	*pt.*
22	51	3	1		122	31	3	1
91	52	2	1		920	33	3	1
9	43	1	0		91	15	1	1
6	41	2	1		9	29	2	1
131	27	1	1		1145	2	3	0

Practical Questions in Ale and Beer Measure.

1. Add together the following quantities of beer, viz. 33 hhds. 51 gal. 2 qts.; 4 hhds. 52 gal. 2 qts.; and 19 hhd. 16 gal. 1 qt. Ans. 58 hhd. 12 gal. 1 qt.

2. The following parcels of Beer were sold to a merchant: first 19 hhd. 27 gal. 3 qts.; second 31 hhd. 21 gal. 2 qts.; at the third time 11 hhd. 6 gal. 3 qts. what was sold him at the three times?

Ans. 62 hhd. 2 gal. 0 qt.

Solid Measure.

By this is measured all such things as have length, breadth and thickness; such as stone, timber, wood, bark, &c.

1728 Inches	make	1 Foot.	marked	*in. ft.*
27 Feet	"	1 Yard.	"	*yd.*
40 Feet of round, or 50 feet of hewn Timber		1 Ton, or Load.		*ton.*

EXAMPLES.

H. tons.	ft.	in.		Yds.	ft.	in.
222	49	1721		234	26	1727
321	36	246		678	21	1672
26	41	1000		565	20	1242
9	36	1259		69	21	43
581	14	770		1549	9	1228

Practical Questions.

1. What is the sum of the three following sticks of timber, viz. the first, 3 tons, 49 ft. 1672 inches; the second, 4 tons 47 ft. and 1000 in.; the third, 6 tons, 40 ft. 1001 in. Ans. 15 tons, 38 ft. 217 in.

2. Add together the following parcels, viz. 29 tons, 30 ft.; 56 tons, 39 ft. 127 in.; 61 tons, 19 ft.; and 71 tons, 27 ft. 1649 in.

Ans. 219 tons, 36 ft. 48 inch.

WOOD AND BARK MEASURE.

Wood and bark are bought and sold by the cord or foot; a foot of wood or bark contains 16 solid feet, or one eighth of a cord.

1728	Inches	make	1 Solid foot.	marked	*in. ft.*
16	Solid Feet	"	1 Foot of wood.	"	*ft.*
8	Feet of wood	"	1 Cord.	"	*cord.*
128	Solid Feet	"	1 Cord.	"	*cord.*

EXAMPLES.

cords.	ft.	in.		cords.	ft.	in.
9	127	1642		64	90	146
2	106	642		9	10	140
40	50	60		70	80	90
61	11	9		10	21	81
114	33	625		154	73	407

Practical Questions in Wood and Bark Measure.

1. Add together the following parcels of wood, viz. 34 cords, 120 feet; 72 cords, 21 feet; and 122 cords.

Ans. 259 cords, 13 s. ft.

2. Add 3 cords 4 feet, of wood, 12 solid feet; 6 cords 5 feet of wood, and 12 solid feet; 9 cords and 6 feet of wood together. Ans. 20 cords, 8 s. ft.

Dry Measure.

By this measure is bought and sold salt, corn, and all kinds of grain; 268·8 solid or cubic inches make one gallon of corn &c.

2 Pints	make	1 Quart,	marked	*pt. qt.*
4 Quarts	"	1 Gallon.	"	*gal.*
2 Gallons	"	1 Peck.	"	*pk.*
8 Quarts	"	1 Peck.	"	*pk.*
4 Pecks or 32 qts.		1 Bushel.	"	*bu.*
8 Bushels	"	1 Quarter.	"	*qr.*
36 Bushels	"	1 Chaldron.	"	*ch.*

EXAMPLES.

Ch.	*bu.*	*pks.*	*gal.*	*qts.*	*pts.*	*Qr.*	*bu.*	*pks.*	*gal.*	*qts.*	*pts.*
654242	32	2	1	2	0	42	7	3	1	3	1
52312	31	0	0	3	1	312	6	2	0	2	0
213	20	3	1	2	0	743	2	1	1	1	0
4201	11	2	0	1	1	7	6	3	0	3	1
710970	24	1	0	1	0	1106	7	3	0	2	0

Practical Questions in Dry Measure.

1. Add together the following parcels, viz. 1627 bushels, 3 pecks, 7 qts. 1 pt.; 972 bu. 2 pks. 1 qt.; 2471 bu. 1 pk. 2 qts. 1 pt. Ans. 5071 bu. 3 pks. 3 qts.

2. The following quantities of coal were sold to a Merchant, viz. 41 chal. 30 bu. 3 pks.; 51 chal. 35 bu. 1 pk.; and 60 chal. 7 bu.; what was the quantity sold? Ans. 154 chal. 1 bu. 0 pk.

Cloth Measure.

By this measure is bought and sold cloths and silks, &c.

4 Nails	make	1 Quarter,	marked	*na. qr.*
4 Quarters	"	1 Yard.	"	*yd.*
3 Quarters	"	1 Ell Flemish.	"	*E. Fl.*
5 Quarters	"	1 Ell English	"	*E. E.*
6 Quarters	"	1 Ell French	"	*E. F.*

EXAMPLES.

F. E.	qr.	na.	E. E.	qr.	na.	E. Fl.	qr.	na.	Yds	qr.	na.
6543	5	1	244	4	3	246	2	2	126	3	3
3454	4	3	312	3	1	234	0	2	245	3	3
6543	3	2	121	1	2	121	2	1	213	1	0
6543	2	1	200	3	3	303	2	1	123	1	3
23085	3	3	879	3	1	916	1	2	709	2	1

Practical Questions in Cloth Measure.

1. Add together the following pieces of cloth, viz. 29 yds. 3 qr. 2 na.; 30 yds. 1 qr. 3 na.; 36 yds. 1 qr. 1 na.; and another piece containing as much as all the others. Ans. 193 yds. 1 qr.

2. How many French ells in the following pieces of cloth, viz. first 22 qr. 3 na.; second 31 qr. 1 na.; third 56 qr. 2 na.; and fourth 91 qr. 1 na.?
Ans. 32 F. ells, 5 qr. 3 na.

OF TIME.

Time is divided into seconds, minutes, hours, days, weeks, months and years.

60 Seconds	make	1 Minute.	marked		*sec. m.*
60 Minutes	"	1 Hour.	"		*h.*
24 Hours	"	1 Day.	"		*d.*
7 Days	"	1 Week.	"		*w.*
4 Weeks	"	1 Month.	"		*mo.*
13 Months		1 Lunar year.	"		*year.*
12 Solar months	"	1 Year.	"		*year.*

365 Days, 5 hours, 48 minutes, 57 seconds, make 1 Solar year.

NOTE. *When any year can be divided by 4 without remainder, it is leap year; and February has 29 days.*

EXAMPLE.

A. D. 1808 ÷ 4 = 452 *and was leap year.*

EXAMPLES.

L.yrs.	mo.	w.	d.	h.	m.	s.
123	11	0	6	23	59	59
128	11	1	4	21	20	40
191	12	3	2	11	12	10
251	11	1	2	10	10	9
691	7	3	2	18	42	58

L.yrs.	mo.	d.	h.	m.	s.
12	12	27	23	59	59
19	9	4	11	12	11
21	4	6	1	10	9
41	2	4	6	9	40
95	2	14	18	31	59

Practical Questions in Time.

1. Add together 12 years, 6 mo. 3 w. 6 d. 23 h. 12 m. 12 s.; 49 years, 5 mo. 2 w. 4 d. 12 h. 9 m.; 1 year, 9 mo. 1 w. 1 d. 1 h. 6 m.

Ans. 63 yrs. 8 mo. 3 w. 5 d. 12 h. 27 m. 12 s.

2. Add 21 yrs. 9 mo. 6 d.; 31 yrs. 6 mo. 21 d.; 6 yrs. 4 mo. 9 d.; and 12 yrs. 7 mo. 10 d. together.

Ans. 72 yrs. 1 mo. 18 d.

COMPOUND SUBTRACTION.

Definition.—Compound Subtraction teaches to find the difference between a larger and a smaller number, which have several denominations.

Rule.—Write down the largest of the two numbers, and under it write down the smallest; observing to place every denomination under that of the same name; dollars under dollars, &c.; begin to subtract in the lowest denomination, take the lower from the upper line; if any particular figure in the lower line in any of the denominations, is larger than the one over it, subtract the lower figure from the number that it takes of this, to make one of the next higher denomination; and to the remainder add the top figure, and set the sum down, and carry one to the next denomination; proceed thus through all the denominations.

Proof.—Add together the remainder and lower line, carry as in Compound Addition; the sum will be like the upper line if the work is right.

American Money.

Dolls.	cts.	m.	Dolls.	cts.	m.	Dolls.	cts.	m.
1241	79	9	4312	29	7	1000	00	0
992	87	8	704	21	6	999	99	9
248	92	1	3608	8	1			1

Practical Questions in American Money.

1. A man lent 3 E. 3 dolls. 3 d. 3 c.; and received 2 E. 2 dolls. 99 cts. and 9 mills; How much remains due? Ans. 10 dolls. 33 cts. 1 m.

2. A man had an estate valued at 3505 dolls. 6 d. 3 cts. 2 m.; he had three sons, to each of whom he gave 504 dolls. 5 cts. 2 m.; he also gave to two daughters, 75 dolls. 75 cts. each; What had he left?
Ans. 1841 dolls. 97 cts. 6 m.

3. A man was worth 9472 dolls. 65 cts.; by a misfortune at sea, he lost 4549 dolls. 75 cts.; What was he worth after he sustained the loss?
Ans. 4922 dolls. 90 cts.

Lawful Money.

£.	s.	d.	£.	s.	d.
647	16	$6\frac{1}{4}$	912	11	$4\frac{1}{4}$
549	17	$7\frac{3}{4}$	897	12	$6\frac{1}{2}$
97	14	$10\frac{1}{2}$	14	18	$10\frac{1}{4}$

Practical Questions in Lawful Money.

1. What is the difference between £141 17*s*. 6*d*. and £41 15*s*. $9\frac{1}{2}$*d*.? Ans. £100 2*s*. $8\frac{1}{2}$*d*.

2. Lent £31 12*s*. $9\frac{1}{2}$*d*. and received £30 10*s*. $11\frac{3}{4}$*d*.; what remains due? Ans. £1 1*s*. $9\frac{3}{4}$*d*.

Troy Weight.

lb.	oz.	pwt.	grs.
223	10	19	22
124	11	12	23
98	11	6	23

lb.	oz.	pwt.	grs.
31234567	6	12	20
13432148	10	13	22
17802418	7	18	22

Practical Questions in Troy Weight.

1. A person had a basin which weighed 3 lb. 10.; it being melted in part; it then was weighed again, and its weight was 2 lb. 11 oz. 7 pwt. 4 grs.; what was melted off? Ans. 10 oz. 12 pwt. 20 grs.

2. A silver smith had 21 lbs. 9 oz. of silver; he refined it by melting, and then weighed it, and its weight was 15 lb. 10 oz. 11 pwt. 19 grs.; what was lost by melting? Ans. 5 lb. 10 oz. 8 pwt. 5 grs.

3. How much silver must be given in exchanging a silver plate for a platter; the weight of the platter being 2 lb. 10 oz.; and the weight of the plate 1 lb. 4 oz. 7 pwt.? Ans. 1 lb. 5 oz. 13 pwt.

Avoirdupois Weight.

T.	cwt.	qr.	lb.	oz.	dr.
12	19	2	27	14	14
9	18	3	24	15	15
3	0	3	2	14	15

T.	cwt.	qr.	lb.	oz.	dr.
134	12	3	20	13	12
94	19	2	21	14	15
39	13	0	26	14	13

Practical Questions in Avoirdupois Weight.

1. A certain vessel was freighted with 22 tons, 13 cwt. 1 qr. of iron; in a storm she was lighted by throwing a part of the cargo overboard; on her arrival at port her cargo weighed but 15 T. 0 cwt. 1 qr.; I demand the quantity lost. Ans. 7 T. 13 cwt.

2. A merchant had 31 cwt. 2 qr. 21 lb. of sugar; he sold to A. 11 cwt. 1 qr.; and to B. 15 cwt. 2 qrs. 17 lb. what had he left? Ans. 4 cwt. 3 qr. 4 lb.

3. A merchant had 1 T. 3 qr. 27 lb. of sugar, it was all stolen but 1 cwt. 1 qr. 8 lb.; I demand the quantity stolen? Ans. 19 cwt. 2 qr. 19 lb.

4. I bought 27 cwt. 2 qr. 19 lb. of flour, and sold 19 cwt. 3 qr. 27 lb.; what remained on hand?

Ans. 7 cwt. 2 qrs. 20 lb.

Apothecaries' Weight.

lb.	oz.	dr.	sc.	grs.		lb.	oz.	dr.	sc.	grs.
14	10	6	2	19		123	6	1	1	19
6	11	7	1	16		94	11	6	2	17
7	10	7	1	3		28	6	2	2	2

Practical Questions.

1. An apothecary had 12 lb. 6 oz. 2 dr. of medicine in a certain vessel; by accident it was broken, and there remained in a broken piece of it, 8 lb. 11 oz. 7 dr. 1 sc. 13 grs.; I demand the quantity lost?

Ans. 3 lb. 6 oz. 2 dr. 1 sc. 7 gr.

2. What remains after taking 19 lb. 6 oz. 3 dr.; from 26 lb. 7 oz. 7 dr. Ans. 7 lb. 1 oz. 4 dr.

3. What is the difference between 119 pounds, 6 ounces: and 111 pounds, 11 ounces? Ans. 7 lb. 7 oz.

Long Measure.

Deg.	mi.	fur.	rds.	ft.	in.	bar.		Mi.	fur.	rds.	ft.	in.	bar.
27	59	6	30	15	11	2		224	3	21	13	1	1
9	27	7	35	13	9	2		95	6	32	14	9	2
18	31	6	35	2	2	0		128	4	28	14½	3	2

Practical Questions in Long Measure.

1. Subtract 24 mi. 3 fur. 26 rods; from 26 mi. and shew the difference. Ans. 1 mi. 4 fur. 14 rods.

2. Express the difference between 200 mi. 6 fur. 29 rods; and 150 mi. 7 fur. 2 rods, 4 yds. 2 ft. 1 bar.

Ans. 49 mi. 7 fur. 26 rods, 0 yds. 0 ft. 11 in. 2 bar.

3. Express the difference between 7 lea. 2 mi 6 fur. 27 rods; and 5 lea. 1 mi. 7 fur. 30 rods.

Ans. 2 lea. 0 mi. 6 fur. 37 rods.

4. A man agreed with another to go 51 miles, 4 furlongs; and he went 60 miles, 2 furlongs; how much further did he go than he agreed to?

Ans. 8 miles, 6 furlongs.

Land, or Square Measure.

Acres	*roods*	*rods*	*feet.*
126	1	39	16
112	3	30	14
13	2	9	2

Acres	*roods*	*rods*	*feet*	*inches.*
2456	1	12	10	11
1367	2	22	9	7
1088	2	30	1	4

Practical Questions in Square Measure.

1. A man's farm contained 246 acres, 1 rood, 7 rods; he sold to A. 27 acres, 2 roods, 1 rod; to B. 39 acres, 39 rods; and to C. 50 acres, 2 roods; how much had he left?

Ans. 129 acres, 7 rods.

2. A man had 700 acres of land; and he had four sons; to the oldest he gave 60 acres 2 roods; and to the second, third and fourth, he gave half as much to each as he did to the first; how much had he left?

Ans. 548 acres, 3 roods.

3. A man had 3472 feet 142 inches of boards, he sold 1249 feet 126 inches; what had he left?

Ans. 2223 feet, 16 inches.

Wine Measure.

Puncheons	*gal.*	*qts.*	*pt.*
12345	70	3	1
10947	75	2	0
1397	79	1	1

Pipes	*hhd.*	*gal.*	*qts.*	*pt.*
23	1	60	2	1
19	0	59	3	0
4	1	0	3	8

Practical Questions in Wine Measure.

1. A wine seller bought 22 hhds. 54 gals. of wine; he sold 12 hhds. 60 gals.; I demand the quantity unsold?

Ans. 9 hhds. 57 gals.

2. A bought 247 gals. 3 qts. 1 pt. of rum; and he sold from it 198 gals. 2 qts.; how much had he left?

Ans. 49 gals. 1 qt. 1 pt.

3. I demand the difference between 3 pipes, 1 hhd. 54 gals.; and 1 pipe, 1 hhd. 61 gals.

Ans. 1 pipe. 1 hhd. 56 gals.

SOLID MEASURE.

H. tons.	*ft.*	*in.*		*H. tons.*	*ft.*	*in.*
246	49	1720		12	16	1111
179	46	1723		9	49	1727
67	2	1725		2	16	1112

Practical Questions in Solid Measure.

1. A man had 249 tons 12 feet of round timber lying in the dock; in a high tide a part of it went adrift; there remained in the dock 142 tons, 12 feet 1721 inches; I demand the quantity lost.

Ans. 106 tons, 39 feet 7 in.

2. What is the difference between 49 tons, 39 feet; and 22 tons, 38 feet, 1272 inches?

Ans. 22 tons, 0 feet, 456 inches.

3. A stone cutter had on hand 1427 feet of stone; he sold 192 feet, 1427 inches; I demand the quantity unsold.

Ans. 1234 feet, 301 inches.

WOOD MEASURE.

cords.	*sd.ft.*	*cords.*	*sd.ft.*	*cords.*	*sd.ft*
1346	127	1327	120	2456	11
1297	121	1319	101	1841	125
49	6	8	19	1114	14

COMPOUND SUBTRACTION.

Practical Questions in Wood Measure.

1. A wood seller bought 127 cords, 120 solid feet wood; and sold 100 cords, 101 solid feet; how mu had he left on hand? Ans. 27 cords, 19 feet

2. A coaster freighted his vessel with 65 cords, 1 solid feet of wood; in a storm he was obliged to lig her by throwing wood overboard; when she arrived port, there was but 21 cords, 106 solid feet on boa I demand the quantity lost? Ans. 44 cords, 12 1

3. What is the difference between 27 cords, 104 fe and 19 cords, 125 feet? Ans. 7 cords, 107 1

Dry Measure.

chal.	bu.	pks.	gal.	qts.	pt.
224	30	2	1	3	1
19	35	3	0	2	0
204	30	3	1	1	1

chal.	bu.	pks.	qts
3456	27	3	6
1967	30	2	7
1488	33	0	6

Practical Questions in Dry Measure.

1. What is the difference between 7953 chal. bushels; and 3789 chal. 35 bushels?

Ans. 4163 chal. 14 bushel

2. A merchant in Boston had a vessel coming fr Virginia freighted with 2478 bushels, 3 pecks of co in a storm she was lighted by shovelling corn overboa on her arrival in port, she had but 2027 bushels, 1 p on board; I demand the quantity lost.

Ans. 451 bu. 2 pk

Cloth Measure.

Fr. E.	qr.	na.
12	4	3
9	5	3
2	5	0

En. E.	qr.	na.
21	4	3
19	2	3
2	1	0

Yds.	qr.	n
121	3	[illegible]
109	2	[illegible]
12	0	[illegible]

Practical Questions in Cloth Measure.

1. A dealer in cloths had 3 pieces containing in all 80 yards, 3 qrs. ; he sold 51 yards, 3 qrs. 3 nails ; I demand what he had left. Ans. 28 yds. 3 qr. 1 na.

2. A Merchant bought 6 pieces of cloth, each piece containing 26 yds. 3 qr. 3 na. ; he sold two pieces ; how many yds. had he left? Ans. 107 yds. 3 qrs.

OF TIME.

L.yrs.	mo.	w.	d.	h.	m.	se.
21	12	3	6	12	21	22
19	10	2	5	15	30	40
[illegible]	2	1	0	20	50	42

Yrs.	d.	h.
125	321	12
109	329	21
15	356	15

Practical Questions in Time.

1. A man hired a servant for 6 years, 4 months, 3 weeks, 6 days ; and he stayed 7 years, 6 months, 3 weeks ; how much longer did he stay than he first agreed to? Ans. 1 yr. 1 mo. 3 w. 1 d.

2. What is the difference between 21 years, 6 months, 3 weeks, 4 days, 12 hours ; and 19 years, 9 months, 2 weeks, 6 days, 21 hours?

Ans. 1 yr. 10 mo. 0 w. 4 d. 15 h.

CASE II.

*When the time is expressed in years and callendar months and days.**

RULE.—Write down the latest date first, (consider whether the month is the first, second, or third, &c. if it is January, write 1 in the column of months; if it is February, write 2; if March, 3, &c. ; and after writing

* *Observe the following Table.*

January is the first month.		July is the 7th month.	
February	2d	August	8th
March	3d	September	9th
April	4th	October	10th
May	5th	November	11th
June	6th	December	12th

the months, write the day of the month) and then write down the other numbers under those of the same denomination; subtract, and the remainder is the difference between the two dates.

EXAMPLES.

1. What is the difference of time between the 16th day of February 1800; and the 19th day of May 1806?

Years.	mo.	d.
1806	5	19
1800	2	16
6	3	3 Ans.

NOTE.—In this example the latest year is written first, May being the 5th month, 5 is put in the column of months, and the day of the month, in the column for days: and then the other denominations are put under those of the same name.

2. How long between the 15th day of June 1729, and the 30th day of August 1806, inclusive?

Ans. 77 years, 2 months, 15 days.

3. I was born the 7th day of May, 1777; what is my age, it being the 20th day of June 1810?

Ans. 33 years, 1 month, 13 days.

4. A. gave B. his note on interest, dated the 21st of August 1804; on the 29th day of November 1809, the note was paid; I demand the time that the note was at interest. Ans. 5 years, 3 months, 8 days.

DECIMAL FRACTIONS.

As the present currency of the United States is calculated wholly by decimals, it is absolutely necessary they should be perfectly understood by the pupil.

DEFINITION.—Decimal Fractions are parts of whole numbers, and are separated therefrom by a point called the separatrix, thus 12·5: which is 12 and 5 tenths, or $12\frac{1}{2}$; all the figures which stand at the left of the sepa-

ratrix are whole numbers; those on the right are fractions. An unit is supposed to be divided into ten equal parts, and the figure next the separatrix on the right expresses the number of those parts; again, one of these parts is supposed to be divided into ten more equal parts; and the next figure in decimals expresses the number of those parts, &c. Thus decimals decrease in a tenfold proportion, as they depart from the separatrix; thus ·5 is 5 tenths; ·05 is 5 hundredths; and ·005 is 5 thousandths, &c. Cyphers placed at the right hand of decimals do not alter their value; ·5 ·50 and ·500 are decimals of the same value and equal to ·5.

DECIMAL NUMERATION TABLE.

Millions.	Hundreds of Thousands.	Tens of Thousands.	Thousands.	Hundreds.	Tens.	Units.	Tenths.	Hundredths.	Thousandths.	Ten Thousandths.	Hundred Thousandths.	Millionths.
7	6	5	4	3	2	1	·1	2	3	4	5	6
	6	5	4	3	2	1	·1	2	3	4	5	
		5	4	3	2	1	·1	2	3	4		
			4	3	2	1	·1	2	3			
				3	2	1	·1	2				
					2	1	·1					
						1						

NOTE.—By the table it is evident that the value of figures *increase* in whole numbers, as they depart from the separatrix; and in the fractions, the value of the figures *decrease* as they depart from the separatrix.

ADDITION OF DECIMALS.

RULE.—Write down the several sums to be added in such a manner, that the units in the whole numbers may stand under units, &c. and tenths in decimals may stand under tenths, &c. Add as in simple addition, and from the right hand of the sum total, point off as many figures for Decimals as are equal to the greatest number of Decimal Figures in either of the sums added.

EXAMPLES.

27·123	341·346	74·789	7·123
1·0341	91·2	7·61741	1·2
·1345	2·023	·214	10·32
28·2916	434·569	82·62041	18·643

Practical Questions.

1. Add 504·29, 64·1, 23·09, and 55·6 together.
Ans. 64·708.

NOTE.—Dimes, cents, and mills are decimals of a dollar; one dime is one tenth; one cent is one hundredth, one mill is one thousandth: therefore the addition of American or Federal money, is the addition of decimals.

2. Add $1327·64 cents; $2341·96 cents 9 mills; and $1572·21 cents together. Ans. $5241·819.

3. Add 46·969, 6·01 and ·946 together.
Ans. $53·925.

SUBTRACTION OF DECIMALS.

RULE.—Write the largest number down first, and the smallest under it, in the same order as in Addition, then subtract the same as in Simple Subtraction.

EXAMPLES.

234·101	91·91	141·1	7·00041
145·164321	81·11234	98·3	5·14864
88·936679			

MULTIPLICATION OF DECIMALS.

Rule.—Multiply exactly as in whole numbers, and from the right of the product point off as many figures for decimals as are equal to the decimal figures in the multiplicand and multiplier, counted together; If at any time there are not so many figures in the product, as this rule requires, supply the defect by prefixing cyphers to the left of the product.

EXAMPLES.

```
  11·23              ·1213
  117·8              ·1321
 ------             ------
   8984               1213
  7861               2426
 1123               3639
1123               1213
 ------             ------
1322·894 pro.      ·01602373 pro.
```

Note.—In the first example there being three decimal figures in the two factors, three figures are pointed off for decimals in the product; in the second example there are eight decimal figures in both factors, and the product consists only of seven figures, therefore I prefixed one cypher and pointed all off for decimals.

No.	Multiplic.			Multiplier.		Product.
1.	1·23	×	by	17·8	=	21·894
2.	10·4	×	by	123	=	1279·2
3.	123	×	by	1·45	=	178·35
4.	·002	×	by	·661	=	·001322

Practical Questions.

1. How much is the product of 29·5 multiplied by ·96? Ans. 28·32.

2. How much will 1000 pounds of butter come to at $11\frac{1}{2}$ cts. per pound? Ans. $115.

3. How much will 64·5 bushels of corn come to, at 12 cts. per bushel? Ans. $72·24 cts.

DIVISION OF DECIMALS.

Rule.—Divide exactly as in whole numbers, and from the right hand of the quotient point off as many figures for decimals, as the decimal figures in the dividend exceed in number the decimal figures in the divisor; if there are not so many figures in the quotient as this rule requires, the defect must be supplied by prefixing cyphers to the left of the quotient; if there are more decimal figures in the divisor than in the dividend, place as many cyphers to the right of the dividend, as will make them equal, and the quotient is whole numbers till the dividend is all brought down; if a remainder still remains, annex cyphers and continue the division; and the quotient thence arising will be decimals.

EXAMPLES.

1. It is required to divide 34·21 by 12·1.

```
12·1)34·21(2·8 Ans.
     242
     ----
     1001
      968
     ----
       33 rem.
```

Note.—There being one more decimal figure in the dividend than in the divisor, one figure is pointed off from the right of the quotient for decimals; cy-

phers might have been annexed to the remainder, and the quotient carried to a greater degree of exactness.

2. It is required to divide 1302 by ·101.

·101)1302·000(12891·089 Ans.

NOTE 2.—In this example the dividend is whole numbers, and the divisor has 3 figures in decimals. I therefore annexed 3 cyphers to the right of the dividend before I divided; and after the dividend was all brought down, I annexed 3 cyphers to the remainder, and continued the division, and got the decimal part of the quotient, viz. ·089.

3. Required to divide 263·146 by 1320.

1320)263·146(·199 $\frac{466}{1320}$ Ans.

NOTE 3.—In this example there are 3 decimal figures in the dividend and the divisor is whole numbers; therefore I pointed off 3 figures from the quotient, for decimals.

4. Required to divide .4567 by 333.

333)·4567(·0013$\frac{238}{333}$ Ans.

NOTE 4.—In this example, there are 4 figures in decimals in the dividend, and the divisor is whole numbers; the quotient has but 2 figures; I therefore prefixed 2 cyphers to the left of the quotient, and pointed all off for decimals.

5. Divide ·07912 by ·111.	Ans. ·71†.*
6. Divide ·00444 by 222.	Ans. ·00002.
7. Divide ·9023 by ·11.	Ans. 8·202†.
8. Divide 15·735 by 12.	Ans. 1·311†.

*This mark(†)signifies that there is a remainder which is omitted in the answer.

REDUCTION OF DECIMALS.

CASE I.

To reduce Vulgar Fractions to Decimals.

Rule.—Annex cyphers to the numerator, and divide by the denominator; the quotient is the decimal sought.

Note.—A vulgar fraction is expressed thus $\frac{5}{6}$; the top figure is a remainder left after division and is called the numerater; the bottom figure is a divisor used in division, and is called the denominator.

EXAMPLES.

1. Reduce $\frac{5}{6}$ to a decimal of the same value.

$$\begin{array}{r} 6)\,5{\cdot}000 \\ \hline {\cdot}833\dagger \end{array}$$ Ans.

2. Reduce $\frac{1}{2}$ to a decimal of the same value.
Ans. ·5.

3. Reduce $\frac{1}{4}$ to a decimal of the same value.
Ans. ·25.

4. Reduce $\frac{3}{4}$ to a decimal of the same value.
Ans. ·75.

CASE II.

To reduce numbers having different denominations to decimals.

Rule.—Write down the several denominations under each other; beginning with the lowest and ending with the highest; on the left of these draw a perpendicular line, and on the left of the line, place such numbers for divisors, against each denomination, as it takes of the lowest to make one of the next higher: annex cyphers to the top figures and divide by the number standing against it on the left of the line; set the quotient (decimally) against the next denomination below; divide the next below by the number standing against it; set the quotient as before; proceed thus through all the denominations, the last quotient is the decimal sought.

EXAMPLES.

1. Reduce 12 pwt. 16 gr. to the decimal of a pound, Troy weight.

24	16·0000
20	12·6666†
12	0·6333†
	·0527† Ans.

2. Reduce 6 oz. 12 pwt. 15 grs. to the decimal of a pound, Troy weight.

24	15·000	
20	12·625†	10
12	6·6312	
	·5526 Ans.	

3. Reduce 2 cwt. 3 qrs. 12 lb. 12 oz. 11 dr. to the decimal of a ton, Avoirdupois weight.

16	11·
16	12·
28	12·
4	3·
20	2·
	·1432† Ans.

4. Reduce 3 qr. 3 na. to the decimal of a yard, Cloth measure.

4	
4	
	·9375 Ans.

5. Reduce 2 miles 6 fur. 20 rods, 12 ft. 6 in. 2 bar. to the decimal of a league, Long measure. Ans. ·9382†.

6. Reduce 3 roods, 30 rods, 29 yds. to the decimal of an acre, Land measure. Ans. ·9434†.

7. Reduce 56 gal. 3 qts. 1 pt. to the decimal of a hhd. allowing 63 gal. to a hhd. Ans. ·9027.

8. Reduce 39 ft. 1727 in. to the decimal of a ton of round timber. Ans. 9999†.

9. Reduce 1 pk. 2 qts. 1 pt. to the decimal of a chaldron. Ans. ·0091†.

10. Reduce 12 mo. 3 wks. 6 dys. 23 h[illegible] 59 min. 12 sec. to the decimal of a year. Ans. ·9999†.

11. Reduce 2 min. to the decimal of a month, allowing 28 days to a month. Ans. ·00004†.

12. Reduce 1 pint to the decimal of a hhd. wine measure. Ans. ·0019†.

13. Reduce 1 week to the decimal of a year, allowing 13 months to a year. Ans. ·01923†.

14. Reduce 1 minute to the decimal of a year, allowing 360 days to a year. Ans. ·000001†.

15. Reduce 1 dram to the decimal of a ton, Avoirdupois weight. Ans. ·000001†.

NOTE.—A decimal table of weights and measures might be made by Case II, which would be very convenient in a counting room, in which the several denominations in weights and measures might be reduced to the decimal of their respective Integers in the following manner.

CLOTH MEASURE.

The parts of a yard reduced to the decimal of a yard.

1	qr.	is	·25	1	na.	is	·0625
2	"	"	·5	2	"	"	·125
3	"	"	·75	3	"	"	·1875

Use of such a Table

Suppose it were required to reduce 3 qr. 1 na. to the decimal of a yard: Take the decimal of 3 qr. from the table, and the decimal of 1 na. and add them together, their sum will be the decimal sought.

The decimal of 3 qr. is ·75
The decimal of 1 na. is ·0625

·8125

CASE III.

To express the value of any decimal in the several denominations of the integer.

Rule.—Multiply the decimal by the next denomination, point off as many figures for decimals as is required by the rule in multiplication of decimals; then multiply the last decimal by the next denomination, and so on to the last; the figures on the left of the separatrix are the value of the decimal in the denominations of the integer.

EXAMPLES.

1. Required the value of ·0527 of a lb. Troy weight.

lb. ·0527
12

oz. ·6324
20

pwt. 12·6480
24

grs. 15·5520

Ans. 12 pwt. 15† grs.

2. Required the value of ·5526 of a lb. Troy weight.
Ans. 6 oz. 12 pwt. 14† grs.

3. What is the value of ·1432 of a ton?
Ans. 2 cwt. 3 qr. 12 lb. 12 oz. 4† dr.

4. What is the value of ·9017 of a lb. Apothecaries' weight? Ans. 10 oz. 6 dr. 1 sc. 13† grs.

5. What is the value of ·9376 of a yard, Cloth measure?
Ans. 3 qr. 3† na.

6. What is the value of ·9436 of a league, Long measure? Ans. 2 mi. 6 fur. 25 rds. 4 yds. 2 ft. 1† in.

7. What is the value of ·9436 of an acre, Land measure.
Ans. [illegible] rods.

8. What is the value of ·9999 of a ton of r[illegible] timber?
Ans. 39 ft. ·1721† in.

9. What is the value of ·0099 of a chaldron?
Ans. 1 pk. 3 qts.

10. What is the value of ·0002 of a month, allowing 28 days to a month? Ans. 8 min. 3† sec.

REDUCTION.

Definition.—Reduction teaches to reduce one denomination to another, and retain the same value.

REDUCTION DESCENDING.

Reduction is called descending when it is required to reduce a larger to a smaller denomination, and it is then performed by multiplication.

Rule.—Multiply the highest denomination given, by such a number as will reduce it to the next lower, observing to bring in the parts of the same name, thus continue till you have reduced it to the denomination required.

EXAMPLES.

1. It is required to reduce 444 dols. 16 cts. 5 m. into mills.

dols.	*cts.*	*m.*
444	16	5
100		

44416 cts.
10

Ans. 444165 mills.

2. In 57 dollars 93 cents 5 mills, how many mills?
Ans. 57935 mills.

3. In 4 cwt. 2 qrs. 20 lb. how many pounds, Avoirdupois weight. Ans. 524 lb.

4. In 20 acres, 29 rods, how many square rods?
Ans. 3229 rods.

5. How many inches from Exeter to Dover, it being 18 miles? Ans. 1140480 in.

6. How many inches will reach round the world, it being 360 degrees, each degree containing 69½ miles?
Ans. 1585267200 in.

7. How many solid feet in 20 cords of wood?
Ans. 2560 sd. ft.

8 How many pints are in 1 tun of wine?
Ans. 2016 pts.

9. How many hours in 33 years, 2 months, 12 days, allowing 13 months to a year? Ans. 289920 h.

10. In 29 yards, 2 quarters, 3 nails, how many na.?
Ans. 475 na.

11. In £214 18*s.* 6½*d.*, how many farthings?
Ans. 206330.

12. In £64 19*s.* 6*d.* how many pence?
Ans. 15594.

REDUCTION ASCENDING.

DEFINITION.—Reduction is called ascending when it is required to reduce a smaller, to a larger denomination; and it is then performed by division.

RULE.—Divide the given denomination by such a number as will make one of the next higher; and the last quotient by such a number as will make one of the next &c. until you have reduced it to the denomination required.

EXAMPLES.

1. Reduce 444165 mills into dollars.

10)444165

10)44416 cts. 5 m.

10)4441 dimes 6 cts.

Ans. 444 dol. 16 cts. 5 m.

2. In 57935 mills, how many dollars, &c.?
Ans. $57 93 cts. 5 m.

3. In 524 lb. Avoirdupois, how many cwt. &c.?
Ans. 4 cwt. 2 qrs. 20 lb.

4. In 3229 rods, how many acres, square measure?
Ans. 20 acres, 29 rods.

5. In 1140480 in. how many miles long measure?
Ans. 18 miles.

6. In 1585267200 inches, how many degrees, each containing 69½ miles? Ans. 360 deg.

7. How many cords of wood are in 2560 solid feet?
Ans. 20 cords.

8. In 2016 pints of wine, how many tuns? Ans. 1 tun.

9. In 289920 hours, how many years, allowing 13 mo. to a year? Ans. 33 yrs. 2 mo. 12 d.

10. In 475 nails, how many yards?
Ans. 29 yds. 2 qr. 3 na.

11. In 206330 farthings how many pounds, &c.?
Ans. £214 18s. 6½d.

12. In 15594 pence, how many pounds, &c.?
Ans. £64 19s. 6d.

COMPOUND MULTIPLICATION.

DEFINITION.—Compound Multiplication is a rule much used in business; and teaches, by having the price of one article given, to find the price of any number of the like kind.

CASE I.

When the quantity is whole numbers.

RULE.—Multiply the price and quantity together, the product is the answer; if there are dimes, cents and mills in the price, point off for decimals according to the rule of multiplication of decimals.

EXAMPLES.

1. How much will 1000 lbs. of butter come to at 11 cts. 5 mills per pound?

1000 lbs. $\times$ ·115=$115·000 Ans.

NOTE.—In this example 11 cents and 5 mills are exactly equal to 115 thousandths of a dollar; therefore I multiplied the price by the quantity, the product was 115000; and according to the rule in the multiplication of decimals, I pointed off three figures from the right for decimals, the rest were dollars.

2. How much will 349 pounds of pork come to at ·07 cents per pound? Ans. 24 dolls. 43 cents.

3. How much will an ox come to, whose weight and prices are as follows, viz.—The quarters 205·5, 202, 207 and 200 lbs. at ·06 cents; the hide 70 lbs. at ·07 cents; the tallow 66 lbs. at ·09 cents lb.

Ans. 59 dolls. 71 cts. 0 m.

4. A drover sold 100 lambs in 5 separate lots, 20 to each; the first lot was sold for $1·96 cents each; the second for 1·90 cents; the third for $2·05 cents; the fourth for $2·10 cents; and the fifth at $2·25 cents; I demand the price of the whole. Ans. $203·20 cts.

BILLS OF PARCELS.

Exeter, April 10, 1811.

Mr. A. B. bought of

Mr. C. D.

		Cts.	Dolls. Cts.
6 gallons of West-India rum	at	·96	5·76
7 do. of New-England do.	"	·55	3·85
12 lbs. of hyson tea	"	$1·25	15·00
19 pairs of shoes	"	·96	18·24
20 lbs. of coffee	"	·28	5·60
29 lbs. of rice	"	·04	1·16
90 lbs. of cotton	"	·23	20·70
15 doz. biscuit	"	·15	2·25
			$72·56

Received payment in full.

Signed C. D.

Exeter, April 10,1811.

Mr. J. K. of Portsmouth,

bought of Mr. G. H.

		Cts.	Dolls. Cts.
1000 gallons of West-India run	at	$1·25	
900 do. of molasses	"	·60	
90 cwt. of brown sugar	"	9·50	
15 barrels of flour	"	8·25	
3 crates of ware	"	40·30	
2 cwt. of iron	"	5·60	
69 gallons of Holland gin	"	1·40	
20 cases of knives and forks	"	·75	
650 lbs. of coffee	"	·29	
			$3200·95

Received payment by note, payable in 90 *days.*

Signed G. H.

CASE II.

When there are fractions in the quantity, such as

$\frac{1}{3}$ $\frac{1}{2}$ $\frac{3}{4}$ $\frac{5}{8}$, *&c.*

RULE.—Reduce the vulgar fraction to a decimal, then multiply the quantity and prices together, point off for decimals according to rule; all that are on the left of the separatrix are dollars, and all on the right are parts, viz. dimes, cents, and mills.

EXAMPLES.

1. What will 102$\frac{3}{4}$ yards of India cotton, come to at 29 cents per yard?

Yds. Cts. Dolls. cts. m.

$\frac{3}{4}$=·75 then 102·75×·29=·29·79·7·5 Ans.

NOTE.—In this example $\frac{3}{4}$ reduced to a decimal, gave two decimal places in the quantity, and there were two decimal places in the price; of course there were four places of decimals in the product; the three first figures in decimals, are cents and mills, and the other is parts of a mill, which in business is not worth noticing.

2. What will 21$\frac{1}{2}$ yards of velvet come to, if 1 dollar 25 cents are paid for 1 yard?

Ans. $26 ·87 cents, 5 m.

3. What will 6 $\frac{9}{12}$ of a yard of broadcloth come to, at 6 dollars 75 cents per yard?

Ans. $45 ·56 cts. 2$\frac{1}{2}$ m.

CASE III.

When there are several denominations in the quantity.

RULE.—Reduce the several denominations to the decimal of the highest, by case 2, in reduction of decimals; then multiply the price and quantity together, point for decimals according to rule; the answer will be dolls. cts. and m. and parts of m.

EXAMPLES.

1. How much will 3 cwt. 2 qr. 20 lb. of sugar come to, at $12·10 cts. per cwt.?

28	20·000†8
4	2·714

cwt. 3·678 × 12·10 = $44·50 cts. 3 m. Ans.

Note.—2 qr. 20 lb. reduced to the decimal of a cwt. is equal to 678 thousandths, which I annexed to the hundreds, and multiplied by the price.

2. How much will 173 cwt. 3 qr. 27 lb. of iron come to, at $5·51 cts. per cwt.? Ans. $958·69† cts.

3. How much will 356 acres, 1 rood and 7 rods of land come to, at $17·21 cts. per acre?

Ans. $6131·80 cts. 2†m.

4. What will 64 tons, 3 cwt. of potash come to, at $84·50 cts. per ton? Ans. $5420·67 cts. 5 m.

5. What will 38 cwt. 3 qr. 21 lb. of sugar come to, at $11·52 cts. per cwt.? Ans. $448·55 cts. 4†m.

6. What will the wages of a servant come to for 70 years, 3 mo. 15 d. allowing 26 days to a month, and 12 months to a year, at $6·71 cts. 5 m. per year?

Ans. $472·05 cts. 1 m.

CASE IV.

Rules concerning boards, plank and other articles that are sold by the thousand, or hundred.

Rule.—If the article is sold by the thousand, place a separatrix between the thousands and hundreds; the hundreds, &c. are decimals of a thousand; if the article

is sold by the hundred, place the separatrix between the hundreds and tens; the tens are decimals of an hundred; then multiply the price and quantity together, the product is the answer.

EXAMPLES.

1. How much will 10751 feet of boards come to, at $11·21 cents per thousand?

Feet.		D.cts.		D. cts. m.	
10·751	×	11·21	=	120·51·8†	Ans.

2. How much will 1100 ft. of plank come to, at 33 dollars per thousand? Ans. $36·30 cts.

3. How much will 941 feet of clear boards come to, at $25 per thousand? Ans. $23·52 cts. 5 m.

4. How much will 627 hoops come to, at $1·27 cts. per hundred? 6·27×1·27=$7·96† Ans.

CASE V.

To multiply by fractional parts.

Rule.—Multiply by the numerator and divide by the denominator, the quotient is the answer.

EXAMPLES.

1. What is the value of $\frac{8}{10}$ of a ship, worth $10000
10000×8=80000÷10=$8000 Ans.

2. What is $\frac{5}{7}$ of a house worth, which is valued at $3470?
Ans. $2478·57·1‡.

CASE VI.

Lawful Money and Weights and Measures.

Rule.—If the number is less than 12, multiply the weight or price of one by the number; observing to

carry as in compound addition; if the number is more than 12, multiply by two such numbers as will make the number required; if there are no two such numbers, multiply by two such numbers as will come nearest, and for the other numbers, add or subtract as the case may be.

EXAMPLES.

1. What is the weight of 9 casks of raisins, each weighing 3 cwt. 2 qr. 11 lb. 6 oz.

Cwt.	qr.	lb.	oz.	
3	2	11	6	
			9	
32	1	18	6	Ans.

2. What is the weight of 56 casks of raisins, each weighing 1 cwt. 2 qrs. 12 lb.? Ans. 90 cwt.

3. What is the weight of 105 casks of tobacco, each weighing 3 cwt. 1 qr. 7 lb.? Ans. 347 cwt. 3 qr. 7 lb.

4. How much will 12 oxen come to, at £.10 16*s*. per ox? Ans. £129 12*s*.

5. How much will 272 barrels of flour come to, at £2 10*s*. 6*d*. per barrel? Ans. £686 16*s*.

RULE 2.—Reduce the price or weight to the lowest denomination mentioned, then multiply by the quantity as in Simple Multiplication, and then reduce the product into its proper terms again.

EXAMPLES.

1. How much will 27 thousand of boards come to, at £.2 10*s*. 6½*d*. per thousand?

£.	s.	d.
2	10	6½
20		

```
  50
  12
 ----
 606
   4
 ----
2426
  27
 ----
16982
4852
-----
4)65502(
-------
12)16375(7
-------
20)1364(4
-------
```

£.68 4*s*. 7½*d*. Ans.

2. How much will 51 cwt. of iron come to, at £.2 1*s*. 6*d*. per hundred? Ans. £.105 16*s*. 6*d*.

COMPOUND DIVISION.

DEFINITION.—Compound Division teaches, by having the price of several things given, to find the price of one.

CASE I.

Federal Money.

When the quantity is an even number.

RULE.—Use the price for a dividend, and the quantity for a divisor; divide, observing the same rule as in the division of decimals, and the quotient is the answer, or price of one.

EXAMPLES.

1. If 24 bushels of rye cost \$21, how much is 1 bushel of it worth?

Dol. *Cts.*

24)21·000(·875=87 cts. 5 m. Ans.

2. If 340 bushels of rye cost \$456·25 cts. I demand the price of 1 bushel? Ans. \$1·341$\frac{310}{340}$.

3. If 2020 lb. of cheese cost \$181·80 cts. what did it cost per pound? Ans. \$0·09 cts.

CASE II.

To find the price per cwt. when there are parts in the quantity, such as cwt. qr. &c.

RULE.—Reduce the smaller denominations to the decimal of a cwt. (by case 2d in reduction of decimals) then divide the price by the quantity, as in case 1st; the quotient, pointed according to the rule of decimals, will be the answer.

EXAMPLES.

1. If 2 cwt. 3 qr. of sugar cost \$45·26 cts. I demand the price of 1 cwt.

Cwt. *qr.* *cwt.* *D. cts.*

2 3=2·75)45·26(\$16·458$\frac{50}{275}$ Ans.

NOTE.—In this question 3 qr. reduced to the decimal of a cwt. is equal to ·75, which I annexed to the 2 cwt. for a divisor; and divided \$45·26 cts. by it, and got 16

dolls. in the quotient; I then annexed three cyphers to the remainder, and continued the division, and thereby got the remaining part of the quotient, viz. ·458 $\frac{50}{275}$.

2. If 15 cwt. 2 qr. of rice were sold for $54·25 cts.; I demand the price of 1 cwt. Ans. $3·5 dimes.

3. If 3 cwt. 2 qr. 14 lb. of iron cost $16·67·5; I demand the price per cwt. Ans. $4·6 dimes.

CASE III.

When Cwt. qrs. and lb. are given to find the price per lb.

RULE.—Find the price per cwt. by case 2d; then divide the price per cwt. by 112, the quotient will be the price per lb.: Or, reduce the quantity to pounds for a divisor, using the price for a dividend.

EXAMPLES.

1. If 3 cwt. 2 qr. 14 lb. of iron cost $16·67 cts. 5 m.; I demand the price per pound.

```
Cwt. qr. lb.   cwt.   D.cts.m. D.d.         c. m.
 3    2   14=3·625)16·675(4·6÷112=·041 8/112 Ans.
                   14500
                   -----
                    21750
                    21750
                    -----
```

CASE IV.

Lawful Money.

RULE.—Divide the price by the quantity, the quotient is the answer; if pounds, shillings, and pence are in the price, divide the highest denomination by the quantity, observing to reduce the remainder to the next denomination, adding in the parts of the same name, and continue the division through all the denominations to the lowest.

EXAMPLES.

1. If 24 oxen cost £.246 16*s.* 6*d.*; how much must be paid for one?

```
  £.     s.   d.
24)246   16   6 (£.10 5s. 8½d.
   24
   ——
     6
    20
   ———
 24)136(5s.
    120
    ———
     16
     12
    ———
 24)198(8
    192
    ———
      6
      4
    ———
  24)24(1
     24
     ——
```

CASE V.

To divide by fractional parts.

Rule.—To divide by fractional parts, is the same as multiplying by them; see case 5th, compound Multiplication.

EXAMPLES.

1. What is the value of $\frac{3}{4}$ of an house, which is worth $3000. $3000\times3=9000\div4=\$2250$. Ans.

CASE VI.

When the number of shares are unequal.

RULE.—Divide the sum by the number of simple shares, the quotient will be the share of the first, which multiply by as many so the second has more than the first, and thus continue till you have found all the shares.

PROOF.—Add all the shares together, and if the sum is equal to the sum divided, the work is right.

EXAMPLES.

1. Divide $373·50 cts. among A. B. and C. in such a manner, that B. may have twice as much as A. and C. twice as much as B.

A. has 1 simple share.
B. " 2 " shares.
C. " 4 " shares.

7 number of simple shares.

$373·50 ÷ 7=$53.35$\frac{5}{7}$, A's.
A's, 53·35$\frac{5}{7}$ × 2=106·70$\frac{10}{7}$, B's.
B's, 106·70$\frac{10}{7}$ × 2=213·40$\frac{20}{7}$, C's.

PROOF.—$373·50 cts.

2. Divide $1089·33 cents among 4 persons, and give the second, three times as much as the first; the third, four times as much as the second, and the fourth, five times as much as the third.

Ans. A's $14·33†; B's $42·99†; C's $171·96†; and D's $859·80 cts.; twenty five cts. being lost in fractions.

CASE VII.

When the shares are not equal, but increase by a certain ratio, as 1, 2, 3, 4, 5, &c.

Rule.—Divide the sum by the number of persons, the quotient is a mean, or middle share; from the middle share subtract the ratio, the remainder is the next share that is less; from the last found share subtract the ratio until you have found all the shares that are less; to the middle share add the ratio, the sum is the next share that is larger; to the last found share add the ratio till you have found all the shares that are larger. If the number of persons is an even number, as 4, 6, 8, &c. divide as above, and from the quotient subtract half the ratio and the remainder is one share; add half the ratio to the quotient, the sum is another share; these two shares are the two middle shares; for the shares that are less continue to subtract the ratio, and for those that are larger, add the ratio till you have found all the shares.

EXAMPLES.

1. Divide \$600 among 5 persons in such a manner that B. may have two more than A., and C. two more than B., &c.

$$\$600 \div 5 = \left\{\begin{array}{ll} 116 & \text{A's share,} \\ 118 & \text{B's ``} \\ 120 & \text{C's ``} \\ 122 & \text{D's ``} \\ 124 & \text{E's ``} \end{array}\right\} \textit{Ans.}$$

Proof—\$600.

2. Divide \$640 among 7 persons in such a manner, that the second shall have one more than the first, the third one more than the second, &c.

Ans. A's share, \$88·42$\frac{6}{7}$; B's \$89·42$\frac{6}{7}$; C's \$90·42$\frac{6}{7}$; D's \$91·42$\frac{6}{7}$; E's \$92·42$\frac{6}{7}$; F's \$93·42$\frac{6}{7}$; G's \$94·42$\frac{6}{7}$.

3. Divide $1600 among four persons in such a manner, that the second may have one more than the first, the third one more than the second, &c.

1600·00÷4=400·00 the middle share.

dol.		*dol. cts.*
399·50—100 cts. ratio	=	398·50 A's share.
400·00— ·50 cts. half ratio	=	399·50 B's share.
400·00+ ·50 cts. half ratio	=	400·50 C's share.
400·50+ 100 cts. ratio	=	401·50 D's share.
		$1600·00 Proof.

AVERAGE JUDGMENT.

Definition.—Average Judgment, is the mean, or middle Judgment, of several persons, who are appointed to appraise any particular property.

Rule.—Add together the several sums which the commodity is appraised at, for a dividend; and the number of appraisers for a divisor; divide, and the quotient will be the mean, or middle Judgment required.

EXAMPLES.

1. What is the value of a piece of land, which is valued by A. at $10; by B. at $11·50; by C. at $12·30; and by D. at $13·40 cts. per acre?

A.	1.	-	$10·00
B.	1.	-	11·50
C.	1.	-	12·30
D.	1.	-	13·40
Appraisers	4		4)47·20
		Ans.	$11·80 *cts.*

2. A. B. C. D. E. and F. were appointed to appraise a certain estate; they appraised it as follows,

viz. A. at $3470 ; B. at $3650 ; C. at $3700 ; D. at $3500 ; E. at $3400 ; and F. at $3600 ; I demand the value of the estate.

Ans. $3553·33 cts. 3⅓ m.

3. M. N. O. and P. appraised the ship Lucy as follows, viz. M. at $6700 ; N. at $9000 ; O. at $8750 ; and P. at $7380 ; what is the middle judgment ?

Ans. $7957·5 dimes.

SINGLE RULE OF THREE DIRECT.

Definition.—The Single Rule of Three Direct teaches, by having three numbers given, to find a fourth, that shall have the same proportion to the third, as the second has to the first. If more require more, the proportion is direct; if less requires less, the proportion is also direct; more requiring more, is when the third term is greater than the first, and the sense of the question requires that the fourth term should be greater than the second; less requiring less, is when the third term is less than the first, and the sense of the question requires that the fourth term should be less than the second.

Rule.—State the question, or arrange the three given numbers in such order, that the one which asks the question may stand in the third place;* that number which is of the same name with the third, must possess the first place; the remaining number (which is always of the same name with the number required) must possess the middle place. Reduce the first and third terms, or numbers, into the same denomination; and reduce the middle number, or term, into the lowest denomination mentioned; then multiply the second and

*The third term always asks a question, and is generally preceded by some such words as, What will ? How much ? How far ? How long ? How soon ? What is ? Where will ? &c.

third terms together, and divide the product by first; the quotient will be the answer, or fourth term sought; and always will be of the same denomination as the middle term was in when it was multiplied with the third term; and may be reduced to any other denomination required.

Rule of Three in Decimals.

Rule.—State the question as in the Rule of Three Direct; prepare the terms by reducing the smaller denominations to the decimal of the highest; observing that the Integer in the first and third terms are in the same denomination: multiply, and divide as in the Rule of Three Direct: and point off for decimals as is required in the rule of multiplication and division of decimals.

Note.—As the currency of the United States is a decimal calculation, it becomes most necessary to calculate in that way; but I have done the questions in the Rule of Three by both methods, therefore one will prove the other.

EXAMPLES.

1. If ten sheep are worth $22·22: what are 19 of the kind worth?

	Sheep.		D. cts.			Sheep.
As	10	:	22·22	:	:	19
			19			
			19998			
			2222			
			10)422·18			

42·218=$42·21 cts. 8 m. Ans.

Note.—In the first question 19 sheep is the number that asks the question, and is placed in the third place; 10 being of the same name, viz. sheep, it is placed in

the first place, and the remaining number, viz. $22·22 cents, is the number left, and is used for the middle term; and is of the same name with the numbe sought, viz. money.

The same question by direct proportion.

	Sheep.	*D. cts.*		*Sheep.*
As	10	: 22·22	: :	19

```
           100
         -----
          2222 cents.
            19
         -----
         19998
         2222
         -----
      10)42218
         -----
     100)4221 8/10 cts.
         -----
        $42·21 8/10 Ans.
```

NOTE.—In this example the first and third terms are of the same name, they need no reducing; there being cents mentioned in the middle term, I reduced the whole to cents, and the answer came in cents; which I divided by 100 to bring them into dollars.

2. If 20 acres, 1 rood, 20 rods of land, cost $183·37 cts. 5 m.; what will 37 acres of the same kind be worth?

20 acres, 1 rood, 20 rods = 20·375 acres.

	Acres.		*dolls.*		*acres.*	
As	20·375	:	183·375	: :	37	$333 Ans.

NOTE.—In this example I reduced the one rood, 20 rods to the decimal of an acre; then I multiplied and divided according to the rule of decimals.

The same question done by direct proportion.

	Acr. rood. rds.		*D. cts. m.*		*acres.*	
As	20 1 20	:	183·37·5	: :	37	Ans. $333.

NOTE.—In this example there being rods in the first

term, I brought all the first term into rods, and also brought the third term into rods; and the middle term into mills; then multiplied and divided according to rule, the answer came in mills.

3. If 23 cwt. 3 qr. of sugar is worth $261·25 cts.; I demand what must be given for 2 cwt. 1 qr. of the kind.
Ans. 24 dolls. 75 cts.

The same question done by direct proportion.
Ans. $24 75.

4. What will 4 hhd. of rum come to, containing as follows, *viz.* the first 101½, the second 96¾, the third 89¼, and the fourth 111¾, gallons; if 6½ gallons cost $6·89?
Ans. $423·20 cts. 5 m.

The same question done by direct proportion.
Ans. $423·20 cts. 5 m.

5. If 1000 feet of boards are worth $11·12 cents; I demand the price of 17221 feet.
Ans. $191·49 cts. 7† m.

The same question done by direct proportion.
Ans. $191·49·7† m.

6. If ⅓ of 6 be three; I demand the value of ¼ of 20.
Ans. 7·5.

The same question done by direct proportion.
Ans. 7½.

7. If 6½ dozen pigeons are worth ·65 cents; I demand the price of 29¾ dozen. Ans. $2·97 cts. 5 m.

The same question done by direct proportion.
Ans. $2·97·5.

8. If 65 bushels and 1 peck of corn were spent in a family of 6 persons; I demand the quantity that would be sufficient to support a family of 22 persons for the same time.
Ans. 239·25 bushels.

The same question done by direct proportion.
Ans. 239¼ bushels.

9. How long will 34261 lbs. of beef last an army of 600 men; allowing them to draw $4\frac{1}{2}$ ounces each, and that 3 times per day? Days $67\frac{5476}{8100}$ Ans.

The same question done by direct proportion.

Ans. $67\frac{5476}{8100}$ days.

10. How many times would a wheel, that is 16 ft. 3 inches in circumference, turn round in going round the world on the Equator; allowing a degree there to contain $69\frac{1}{2}$ miles? Ans. 8129575 $\frac{625}{1625}$

The same question done by direct proportion.

Ans. 8129575 $\frac{75}{195}$

11. How far are the inhabitants of the equator carried in a minute, allowing the earth to make one revolution in 24 hours; and allowing a degree to contain $69\frac{1}{2}$ miles? Ans. 17 mi. 3 fur.

The same question done by direct proportion.

Ans. 17 mi. 3† fur.

12. A merchant failing in trade, is owing $6420·20 cents; his effects are worth $3142·75 cents: what will A. lose to whom he owed $960·73 cents? Ans. $490·45.

The same question done by direct proportion.

Ans. $490·45.

13. A merchant failing, is owing $7500; his effects amount to $5640; what can he pay per cent? Ans. $75·2† dimes.

The same question done by direct proportion.

Ans. $75·20† cts.

14. If the earth makes one revolution in one solar day; I demand the time that it is in passing one degree. Ans. 4 minutes.

The same question done by direct proportion.

Ans 4. minutes.

15. If the sun is 4 minutes in passing one degree; I de-

mand the difference of time of its coming to the meridian, at two places which lie 20 degrees apart.

Ans. 1 hour 20 min.

The same question done by direct proportion.

Ans. 1 hour 20 min.

16. What is the insurance upon 3472 dols. at 3½ per cent? Ans. $121·52 cts.

The same question done by direct proportion.

Ans. 121·52 cts.

17. If half an acre of land is worth $59·20 cents; I demand the price of 1¼ acres. Ans. $148.

The same question done by direct proportion.

Ans. $148.

18. I demand the value of $642 against an estate which can pay only ·69 cents on the dollar.

Ans. $442·98 cts.

The same question done by direct proportion.

Ans. $442·98.

19. There is a cistern having 4 cocks; the 1st empties it in 15 minutes; the 2d in 30 minutes; the 3d in 45 minutes; and the 4th in 60 minutes; In what time would it be emptied if they were all running together?

As 15 : 1 : : 120 : 8
30 : 1 : : 120 : 4
45 : 1 : : 120 : 2⅔
60 : 1 : : 120 : 2

16⅔

Cisterns	*min.*	*cistern*	*min.*	*sec.*
As 16⅔ :	120 : :	1 :	7	12 Ans.

20. If £.21 12*s.* be paid for building 60 rods of stone wall, how much must be paid for the building of 96 rods? Ans. £.34 11⅕*d.*

21. What must be given for 19½ yards of broadcloth, if 3 yards of the like kind cost £.19 11*s.* 6*d.*

Ans. £.127 4*s.* 9*d.*

METHOD OF MAKING TAXES.

The first thing requisite in making taxes is to know the rate at which polls and other rateable estate are valued by the statutes of the state.

NOTE.—As these rates are established by the Legislature of the state, they are often altered.

The value of Rateable Estates, as valued by the laws of New-Hampshire in 1811.

		cts.
POLLS.—Each poll from 18 to 70 years of age, except those excused by the statute	at	$1·30
HORSES.—Stallions wintered 3 winters, each	"	·500
Other horse kind wintered 5 winters	"	·70
do. do. 4 do.	"	·50
do. do. 3 do.	"	·30
do. do. 2 do.	"	·10
OXEN.—Oxen five years old, each ox	"	·40
do. four years old do.	"	·30
COWS.—Cows wintered 5 winters each	"	·20
OTHER NEAT STOCK.—All neat stock wintered 3 winters		·10
All neat stock wintered 2 winters	"	·05
ORCHARD LAND.—So much orchard land as will produce 10 barrels of cider or perry is called an acre; and each acre is valued	at	cts. ·30
TILLAGE LAND.—So much land as will produce 25 bushels of corn, or other grain equivalent, is accounted an acre; & each acre is valued	"	·20
MOWING LAND.—As much as will produce 1 ton of English hay yearly, or other hay equivalent is accounted an acre, & each acre is valued	"	·20
PASTURE LAND.—As much pasture land as will keep 1 cow (one year with another,) is called 4 acres; and each acre is valued	"	·05

MILLS, &c.—These are estimated at one twelfth of their neat yearly income after deducting repairs, &c.

BUILDINGS, &c.—Of inhabitants and non residents are valued at half of one per cent, of their real value.

STOCK IN TRADE.—Stock in trade at half of one per cent.

BANK SHARES.—All bank shares at $\frac{3}{4}$ of one per cent.

CARRIAGES.—All carriages of pleasure are valued at half of one per cent. of their real value.

MONEY.—Money at interest, or on hand more than the owner pays interest for, is valued at $\frac{3}{4}$ of one per cent.

Having shown the rates at which rateable estates are valued, I shall now proceed to form an Inventory of the estates to be taxed.

INVENTORY.

Person's names.	Polls, each at $1 30 cts.	Oxen, 5 years old, at $0·40 cts.	Oxen, 4 years old, at $0·30 cts.	Cows 5 years old, at $0·20 cts.	Cattle, 3 years old, at $0·10 cts.	Cattle, 2 years old, at $0·5 cts.			Total amount of rateable estate.
	$1·30	$0·40	$0·30	$0·20	$0·10	$0·5			
A. B.	3	4	2	6	8	8			8·50
C. D.	1	2	3	4	6	1			4·45
E. F.	2	3	1	4	2	7			5·45
G. H.	2			1					2·80
I. J.	1								1·30
	9	9	6	15	16	16			22·50
Proof, $22·50cts.	9 polls, each at $1·30 cts.	9 oxen, 5 years old, each at $0·40 cts.	6 oxen, 4 years old, each at $0·30 cts.	15 cows, five years old, each at $0·20 cts.	16 cattle, 3 years old, each, at $0·10 cts.	16 cattle, two years old, each at $0·05 cts.			Total amount of rateable estate
	11·70	3·60	1·80	3·00	1·60	$0·80			$22·50 cts.

NOTE.—I have for brevity sake omitted several articles of rateable estate in the inventory; those which I have inserted I think will sufficiently explain the method of arranging the same.

The method of finding the amount of each man's rateable estate, and of the Inventory.

RULE.—Multiply each man's number of polls by the value of one; his number of oxen by the value of one; his number of cows by the value of one; and so of all the parcels of rateable estate; add the products together, the sum is his rateable estate; add all the rateable estates together, the sum is the value of the Inventory.

Required the rateable estate of A. B. who has

3 Polls	at	\$1·30	=	\$3·90
4 Oxen five years old	"	·40	=	1·60
2 do. four yrs. old	"	·30	=	·60
6 Cows five yrs. old	"	·20	=	1·20
8 Cattle three years old	"	·10	=	·80
8 do. two yrs. old	"	·05	=	·40
Amount of A. B's. rateable estate.				\$8·50

To prove the Inventory.

RULE.—Add up the column of polls; multiply the sum by the value of one; the product will be the value of all the polls.

In like manner add every column of the inventory, and multiply the sum of each column by the value of one in that column: add the several products together, and the sum of all the products will be equal to the sum of all the rateable estates, if the work is right.

EXAMPLES.

The sum of rateable estates in the preceding Inventory is \$22·50 cts.

The sum of the products of all the polls and other rateable estates is equal to $22·50 cts.
Therefore the work is right

To make the proportion of tax equal, according to the value of each man's rateable estate.

RULE.—Make tables for every separate tax, by making the sum of the inventory the first term; The sum that is to be raised in any one tax, the second term; and one dollar the third term; the number arising from the operation will be what is raised on one dollar of rateable estate: from this, make the table from 1 to 10, 20, or 30 dollars, as you may think necessary.

In the same manner find what is paid on one cent of rateable estate; and from this, make a table from one to 90 cents; and from these tables take each man's tax.

EXAMPLES.

1. Suppose the estates named in the preceding inventory are liable to pay 225 dolls. for the building of a school house; each man's tax is required, in proportion to his rateable estate.

To find what 1 dollar pays.

If $22·50 cts. pay 225 dollars, what will 1 dollar pay?

D. cts.		*D.*			*D.*		
22·50	:	225	:	:	1	:	10 dolls. Ans.

To find what 1 cent will pay.

If $22·50 cts. pay 225 dolls. what will 1 cent pay?

D. cts.		*D.*			*cts.*		
22·50	:	225	:	:	01	:	10 cts. Ans.

Dollar Table, from one dollar to eighteen.				Cent Table from one to ninety cts. inclusive.			
1	- dollar	- pays -	$10	1	- cent	- pays	- ·10
2	"	"	20	2	"	"	·20
3	"	"	30	3	"	"	·30
4	"	"	40	4	"	"	·40
5	"	"	50	5	"	"	·50
6	"	"	60	6	"	"	·60
7	"	"	70	7	"	"	·70
8	"	"	80	8	"	"	·80
9	"	"	90	9	"	"	·90
10	"	"	100	10	"	"	1·00
11	"	"	110	20	"	"	2·00
12	"	"	120	30	"	"	3·00
13	"	"	130	40	"	"	4·00
14	"	"	140	50	"	"	5·00
15	"	"	150	60	"	"	6·00
16	"	"	160	70	"	"	7·00
17	"	"	170	80	"	"	8·00
18	"	"	180	90	"	"	9·00

To make the tax by the help of the tables.

1. Required A. B's. tax, his rateable estate being $8·50 cts.

$8·00 cts. rateable estate pays $80·00 cts. tax.
·50 cts. rateable estate pays 5·00

Amount of A. B's. tax $85·00

2. Required C. D's. tax, his rateable estate being $4·45 cts.

$4·00 cts. rateable estate pays $40·00 cts. tax.
·40 cts. rateable estate pays 4·00
·05 cts. rateable estate pays ·50

Amount of C. D's. tax $44·50

In the same manner take each man's tax from the tables, and their several proportions will be as follows.

FIRST TAX LIST.

A. B.	$85·00
C. D.	44·50
E. F.	54·50
G. H.	28·00
I. J.	13·00

PROOF.—Add all the taxes together, the sum must be like the sum raised, if the work is right, except what is lost in fractions. In this example the amount of taxes is just equal to the sum to be raised, therefore the work is right.

Amount of tax $225·00.

NOTE.—It must be remembered that no one set of tables will answer for any two different taxes, unless the sum of the two different taxes are alike.

Example second.

1. Suppose the estates in the preceding inventory are taxed in a further sum of 19 dollars; I demand the proportion to each man, according to their several rateable estates.

To find what one dollar pays.

Say if 22 dolls. 50 cents pay 19 dollars; what will 1 dollar pay?

D. cts. *D.* *D.* *cts. m.*
As 22·50 : 19 : : 1 : ·84 4† Ans.

To find what one cent will pay.

Say if 22 dolls. 50 cents pay 19 dollars, what will 1 cent pay?

D. cts. *D.* *ct.* *cts. m.*
As 22·50 : 19 : : ·01 : 00 ·8†

Dollar Table from one dollar to eighteen.			D. c. m.	Cent Table from one cent to ninety.			cts. m.
1-	dollar -	pays -	0·84·4	1 -	cent -	pays -	·00·8
2	"	"	1·68·8	2	"	"	·01·6
3	"	"	2·53·2	3	"	"	·02·4
4	"	"	3·37·6	4	"	"	·03·2
5	"	"	4·22·0	5	"	"	·04
6	"	"	5·06·4	6	"	"	·04·8
7	"	"	5·90·8	7	"	"	·05·6
8	"	"	6·75·2	8	"	"	·06·4
9	"	"	7·59·6	9	"	"	·07·2
10	"	"	8·44·0	10	"	"	·08
11	"	"	9·28·4	20	"	"	·16
12	"	"	10·12·8	30	"	"	·24
13	"	"	10·97·2	40	"	"	·32
14	"	"	11·81·6	50	"	"	·40
15	"	"	12·66·0	60	"	"	·48
16	"	"	13·50·4	70	"	"	·56
17	"	"	14·34·8	80	"	"	·64
18	"	"	15·19·2	90	"	"	·72

To make the second tax list.

1. From the last tables it is required to take A. B's. tax His rateable estate is $8·50.

8 dollars pay $6·75·2
50 cents pay ·40·0

Am't. of A. B's. tax $7·15·2

Proceed in like manner to find each man's tax, and their several proportions will stand as in the annexed list.

SECOND TAX LIST.

A. B.	$7·15·2
C. D.	3·73·6
E. F.	4·58
G. H.	2·32·8
I. J.	1·08·4

I find by adding up the tax list, that the sum of taxes is 12 cents less than the sum which was to be raised; which was lost in remainders.

NOTE:—In assessing taxes, the law allows the assessor to assess a certain sum, over and above the necessary sum to be raised; or else the tax would not be large enough when there are remainders, which is almost always the case.

INVERSE PROPORTION.

DEFINITION.—Inverse proportion teaches by having three numbers given to find a fourth, that shall have the same proportion to the third as the first has to the second; when more requires less, the proportion is Inverse; when less requires more, the proportion is also Inverse; more requires less, when the third term is larger than the first, and the sense of the question requires the fourth to be less than the second; less requires more when the third term is smaller than the first, and the sense of the question requires the fourth term to be greater than the second.

RULE.—Make that number which asks the question the third term; that, which is of the same name, the first term; and the other remaining number must be the middle term; multiply the first and second terms together, and divide the product by the third; the quotient will be the answer required.*

*I have followed the same method in *Inverse Proportion* as I did in direct proportion: that is, I have done the sums in decimals and then the other way.

EXAMPLES.

1. If 8 men can build a tower in 12 days; I demand how long it would take them, if 4 more were added to their number?

	men.	*days.*	*men.*	*men.*
As	8 :	12 : :	8 +	4
		8		

12)96(8 da. Ans.

NOTE.—In this example it is evident that 12 men would do the work quicker than 8, therefore more requires less; more men, requires less time.

The same question done the other way.

Ans. 8 days.

2. There is a piece of land 16·5 rods long; I demand the width to make an acre, allowing 20 links to a rod.

Ans. 9·696 rods.

The same question done the other way.

Ans. 9 rds. 13† lin.

3. A ship at sea is provided with bread and water sufficient to supply 20 men 9 months, 30 days to a month; but finding a wreck in which were 3 men and 3 boys, to whom they were willing to communicate relief: I demand the time they all can draw their allowance, allowing 2 boys equal to a man.

Ans. 7·346 mo.

The same question done the other way.

Ans. 7 months 10† days.

4. There is a piece of land that is 10 rds. 10 links in width; I demand the length to make an acre, allowing 20 links to a rod. Ans. 15·238 rds.

The same question done the other way.

Ans. 15 rods 4† links.

5. How much in length of that which is 5 rods wide will make an acre? Ans. 32 rds.

The same question done the other way.

Ans. 32 rds.

6. How much carpeting that is 1·5 yds. wide will cover a floor that is 7·5 yds. long, and 5 yds. wide?

Ans. 25 yds.

The same question done the other way.

Ans. 25 yds.

DOUBLE RULE OF THREE.

Definition.—The Double Rule of Three teaches to solve such questions as require two statings in the Single Rule of Three; five numbers are given to find a sixth.

Rule.—State the question by placing that number which is the principal cause of gain or loss, in the first place: that number which represents time, distance, &c. (that the first is gaining, or losing) in the second place; that number which represents the gain or loss in the third place; then place the other two numbers under those of the same name; and if the term sought, or the blank place, fall under the third term; then multiply the three last terms together for a dividend, and the other two for a divisor; but if the blank place fall under the first, or second term, then multiply the first, second and last terms together for a dividend, and the other two for a divisor.

Note.—The sixth term or answer always will come of the same name, and of the same denomination, of the term directly over the blank place.

To solve questions that belong in the DOUBLE RULE of THREE, by two statements in the SINGLE RULE of THREE.

Rule.—Make the number which is the principal cause of gain, or loss, the first term; the gain, or loss the

second; the number, which is the demand of the question the third; the answer to this first statement will show what the third term gained, or lost, in a time that the first term was gaining or losing, (which time is always mentioned in the question) therefore, say in the second stating, as the space of time or distance, &c. mentioned in the question, is to the answer of the first statement, so is the required time or distance, &c. to the answer.

NOTE.—I have done the questions in the Double Rule of Three, first, by stating the five numbers at once; and then by two statings in the Rule of Three direct; the learner may follow my examples or not, as may best suit his inclination.

EXAMPLES.

1. If 200 dollars in 12 months will gain 12 dollars; I demand how many 50 dollars will gain in six months;

dolls.		*mo.*		*dolls.*
200	:	12	: :	12
50	:	6	: :	

Three last terms $50 \times 6 \times 12 = 3600$. dividend.
Two first terms $200 \times 12 = 2400$. divisor.
$3600 \div 2400 = \$1 \cdot 50$ Ans.

The same question done by two statements.

	Dolls.		*dolls.*		*dolls.*		*dolls.*
As	200	:	12	: :	50	:	3

	Months.		*dolls.*		*months.*		*doll. cts.*
As	12	:	3	: :	6	:	1·50. Ans.

2. If 4 men spend 60 dollars, going 300 miles: I demand what is sufficient for the expense of 20 men, and one boy 700 miles, allowing the boy, one half a man's expense? Ans. \$717·50.

The same question done by two statements.

	men.		*dolls.*		*men*		*dolls.*
As	4	:	60	: :	20·5	:	307·5

	miles.		*dolls.*		*miles.*		*dolls.*
As	300	:	307·5	: :	700	:	717·5 Ans.

3. If 3 men can build 360 rods of wall in 24 days; I demand how many rods 7 men would build in 27 days? Ans. 945 rds.

The same question done by two statements.

	men.		*rods.*		*men.*		*rods.*
As	3	:	360	: :	7	:	840

	days.		*rods.*		*days.*		*rods.*
As	24	:	840	: :	27	:	945 Ans.

4. If 3 men in 24 days can build 360 rods of wall; I demand the number of men necessary to build 945 rods in 27 days? Ans. 7 men.

The same question done by two statements.

Ans. 7 men.

5. If 50 men can build a bridge in 144 days; I demand the number of men necessary to build a like bridge in 720 days? Ans. 10 men.

The same question done by two statements.

	days.		*bridge.*		*days.*		*bridges.*
As	144	:	1	: :	720	:	5

	bridges.		*men.*		*bridge.*		*men.*
As	5	:	50	: :	1	:	10 Ans.

6. A man lent a friend 600 dollars, for 6 months; for which he received 9 dollars interest: I demand the sum that will gain the same interest in 2 months? Ans. $1800.

The same question done by two statements.

	mo.		*dolls.*		*mo.*		*dolls.*
As	6	:	9	: :	2	:	3

	dolls.		*dolls.*		*dolls.*		*dolls.*
As	3	:	600	: :	9	:	1800 Ans.

7. A. received of B. 9 dollars, for the loan of 600 dollars six months; now B. wishes to hire of A. 1800 dollars until the loan should amount to the same sum; how long may he keep it? Ans. 2 months.

The same question done by two statements.

	dolls.		*interest.*		*dolls.*		*interest.*
As	600	:	9	: :	1800	:	27

	dolls.		*mo.*		*dolls.*		*mo.*
As	27	:	6	: :	9	:	2 Ans.

VULGAR FRACTIONS.

Definition.—Vulgar Fractions are parts of whole numbers, and are expressed thus, $\frac{1}{25}$, $\frac{6}{7}$, &c. The top figure is a remainder left after division, and is called the numerator; the bottom figure is the divisor used in division, and is called the denominator. Fractions are read thus, $\frac{1}{10}$, is read one tenth; and $\frac{6}{7}$, is read six sevenths, &c.

Fractions are proper, improper, compound, or mixed; a Proper Fraction has its numerator the smallest; an Improper Fraction has its numerator equal, or the largest; a Compound Fraction is the fraction of a fraction, and is coupled by the word *of*; a mixed number is a whole number and fraction.

A proper fraction is written thus, $\frac{1}{2}$, $\frac{3}{8}$, $\frac{7}{8}$, $\frac{8}{12}$, &c.
An improper fraction is written thus, $\frac{3}{2}$, $\frac{4}{3}$, or $\frac{5}{5}$, $\frac{7}{4}$, &c.
A compound fraction is written thus, $\frac{1}{2}$ of $\frac{3}{4}$ of $\frac{1}{4}$ of $\frac{4}{5}$.
A mixed number is written thus, $12\frac{3}{4}$, $6\frac{2}{10}$, $5\frac{3}{4}$, &c.

CASE I.

To find the greatest common measure.

RULE.—Divide the denominator by the numerator, and the last divisor by the last remainder; the last divisor used is the common measure; if 1 is the last divisor, the fraction is in its lowest terms.

EXAMPLES.

1. The greatest common measure of $\frac{26}{252}$ is required.

```
26)252(9
   234
   ———
   18)26(1
      18
      ——
       8)18(2
         16
         ——
          2)8(4
            8
            —
```

The last divisor being 2, it is the greatest common measure of the fraction.

2. What is the greatest common measure of $\frac{864}{1064}$? Ans. 8.

3. What is the greatest common measure of $\frac{84}{460}$? Ans. 4.

CASE II.

To reduce fractions to their lowest terms.

RULE.—Find a common measure by case 1st; divide the numerator and denominator of the given fraction, by the common measure, the quotient is the fraction in its lowest terms.

EXAMPLES.

1. Reduce $\frac{322}{464}$ to its lowest terms.

$\frac{322}{464} \div 2$ Com. m.$=\frac{161}{232}$ Ans.

2. It is required to reduce $\frac{864}{1064}$ to its lowest terms. Ans. $\frac{108}{133}$.

3. Required to reduce $\frac{64}{460}$ to its lowest terms. Ans. $\frac{16}{115}$.

CASE III.

To reduce a mixed number to an improper fraction.

RULE.—Multiply the whole number by the denominator of the fraction, to the product add the numerator of the fraction; this sum placed over the given denominator will form the fraction required.

EXAMPLES.

1. Reduce $10\frac{3}{4}$ to an improper fraction.

$10\times4=40+3=43$ numerator, $\frac{43}{4}$ Ans.

2. Reduce $112\frac{1}{3}$ to an improper fraction.

$112\times3+1=\frac{337}{3}$ Ans.

3. Reduce $28\frac{9}{10}$ to an improper fraction.

Ans. $\frac{289}{10}$.

CASE IV.

To reduce an improper fraction to its proper terms.

RULE.—Divide the numerator by the denominator, the quotient is the whole number; the remainder is the numerator of the fraction.

EXAMPLES.

1. Reduce $\frac{43}{4}$ to its proper terms.

$43\div4=10\frac{3}{4}$. Ans.

2. Reduce $\frac{337}{3}$ to its proper terms.

Ans. $112\frac{1}{3}$.

3. Reduce $\frac{289}{10}$ to its proper terms.

Ans. $28\frac{9}{10}$.

CASE V.

To find the least common denominator.

Rule.—Divide the given denominators by any number that will divide two, or more of them without a remainder; then divide the undivided numbers and last quotients, by any number that will divide two or more of them, without a remainder; and thus continue dividing till no two numbers can be divided without a remainder; then multiply the divisors and remainders together, the product is the common denominator required.

EXAMPLES.

1. What is the least common denominator of $\frac{5}{6}$, $\frac{1}{8}$, $\frac{4}{7}$, $\frac{3}{10}$, $\frac{9}{18}$?

3	6	8	7	10	18	given denominators.
2	2	8	7	10	6	

com. denom.

$1\times4\times7\times5\times3\times3\times2=2520$ Ans.

2. What is the common denominator of $\frac{2}{9}$, $\frac{5}{14}$, $\frac{3}{8}$, $\frac{13}{16}$, and $\frac{3}{4}$? Ans. 1008.

CASE VI.

To reduce fractions to a common denominator.

Rule.—Find the common denominator by case 5th, and use it as a dividend; use each given denominator as a divisor; divide, multiply the quotients by the respective numerators, and the product placed over the common denominator will form the fractions required.

EXAMPLES.

Reduce $\frac{3}{4}$, $\frac{2}{5}$, $\frac{7}{8}$, $\frac{9}{10}$ to common denominators.

Com. denom. $40\div4=10\times3=30$ 1st numerator.
$40\div5=8\times2=16$ 2d numerator.
$40\div8=5\times7=35$ 3d numerator.
$40\div10=4\times9=36$ 4th numerator.

The new numerators being written over the common denominator, the fractions appear thus $\frac{35}{40}$, $\frac{16}{40}$, $\frac{30}{40}$, $\frac{36}{40}$ Ans.

2. Reduce $\frac{2}{6}$, $\frac{8}{10}$, $\frac{6}{14}$, $\frac{8}{16}$, and $\frac{4}{6}$ to common denominators. Ans. $\frac{560}{1680}$, $\frac{1344}{1680}$, $\frac{720}{1680}$, $\frac{840}{1680}$, $\frac{1120}{1680}$.

3. Reduce $\frac{4}{6}$, $\frac{8}{10}$, $\frac{9}{12}$, and $\frac{11}{14}$, to common denominators. Ans. $\frac{280}{420}$, $\frac{336}{420}$, $\frac{315}{420}$, $\frac{330}{420}$.

CASE VII.

To reduce compound fractions to simple ones.

RULE.—Multiply all the numerators together for a new numerator; and all the denominators together for a new denominator, and it is done.

EXAMPLES.

1. Reduce $\frac{1}{2}$ of $\frac{3}{4}$ of $\frac{5}{6}$ of $\frac{4}{7}$ of $\frac{6}{8}$ to a simple fraction.

$$\frac{\text{Num. } 1\times3\times5\times4\times6=360}{\text{Dem. } 2\times4\times6\times7\times8=2688}\text{ Ans.}$$

2. Reduce $\frac{2}{16}$ of $\frac{1}{2}$ of $\frac{3}{6}$ of $\frac{1}{12}$ of $\frac{9}{16}$ to a simple fraction, and to its lowest terms. Ans. $\frac{27}{1600}$.

CASE VIII.

To reduce a fraction of a lower denomination to the fraction of a higher, retaining the same value.

RULE.—Reduce the fraction to a compound one, by comparing it with all the denominations between itself, and the denomination, to which you would reduce it; then reduce it to a simple fraction by case 7th.

EXAMPLES.

1. Reduce $\frac{3}{10}$ of a mill to the fraction of a dollar. By comparing it, it becomes $\frac{3}{10}$ of $\frac{1}{10}$ of $\frac{1}{10}$ of $\frac{1}{10}=\frac{3}{10000}$ Ans.

2. Reduce $\frac{1}{2}$ of a grain to the fraction of a pound Troy weight.

$\frac{1}{2}$ of $\frac{1}{24}$ of $\frac{1}{20}$ of $\frac{1}{12}$ of $\frac{1}{1}=\frac{1}{11520}$ Ans.

3. Reduce $\frac{3}{4}$ of a day to the fraction of a year containing 365 days. Ans. $\frac{3}{1460}$.

Rule 2.—Reduce the Integer to the same denomination with the denominator of the fraction, for a denominator; over which place the numerator of the given fraction, and it will form the fraction required.

EXAMPLES.

1. Required to reduce $\frac{3}{10}$ of a mill, to the fraction of a dollar.

dolls. d. c. m. tenths.

$1 \times 10 \times 10 \times 10 \times 10 = 10000$ denominator.

Ans. $\frac{3}{10000}$.

2. Reduce $\frac{3}{4}$ of a day to the fraction of a year.

Ans. $\frac{3}{1460}$.

CASE IX.

To reduce the fractions of a higher, to the fraction of a lower denomination, retaining the same value.

Rule.—Multiply the numerator of the given fraction into the denominators of the compound ones between itself and the denomination to which you would reduce it, for a new numerator; which being placed over the given denominator, will form the fraction required.

Rule 2.—Invert the denominations between the given denomination, and the one to which you would reduce it; then multiply all the numerators together for a new numerator, and the denominators, for a new denominator.

EXAMPLES.

1. Reduce $\frac{3}{10000}$ of a dollar, to the fraction of a mill.

$$\frac{3}{10000} \quad \overset{D.}{\frac{1}{1}} \quad \overset{d.}{\frac{1}{10}} \quad \overset{cts.}{\frac{1}{10}} \quad \overset{m.}{\frac{1}{10}} = \frac{3000}{10000} \text{ Given Denom. Ans.}$$

2. Reduce $\frac{3}{1460}$ of a year to the fraction of a day.

$\frac{3}{1460}$ of $\frac{1}{1}$ $\frac{3}{365}$ inverted is $\frac{3}{1460}$ of $\frac{1}{1}$ of $\frac{365}{1}$

and $\frac{3}{1460} \times \frac{1}{1} \times \frac{365}{1} = \frac{1095}{1460}$ Ans.

CASE X.

To express the value of a fraction in the several denominations of the Integer.

RULE.—Multiply the numerator of the fraction into the known denominations of the Integer, and divide the product by the denominator, the quotient is the value of the fraction, in the denominations of the Integer.

EXAMPLES.

1. What is the value of $\frac{9}{10}$ of a dollar?
   1 Dol.$=100 \times 9 = 900 \div 10 = 90$ cts. Ans.
2. What is the value of $\frac{4}{7}$ of an cwt. avoirdupois?
   Ans. 2 qr. 18 lb. 10 oz. $10\frac{2}{7}$ dr.
3. What is the value of $\frac{3}{4}$ of a cord of wood?
   Ans. 96 solid feet.
4. What is the value of $\frac{9}{16}$ of a yard?
   Ans. 3 qr. $2\frac{4}{16}$ na.

CASE XI.

To reduce parts of an Integer which are expressed in several denominations, to the fraction of a greater of the same kind.

RULE.—Reduce the several denominations to the lowest denomination mentioned, for a numerator; and reduce the integer to the same denomination for a denominator.

EXAMPLES.

1. It is required to reduce 1 dime, 6 cts. and 9 mills, to the fraction of an Eagle.

$$\begin{array}{ll} \text{1 dime 6 cts. 9 m.} & = \\ \text{1 Eagle} & = \end{array} \frac{169}{10000} \text{ Ans.}$$

2. Reduce 2 rods 12 feet to the fraction of a mile, and to its lowest terms.

Ans. $\frac{3}{352}$.

3. Reduce 10 feet 100 inches to the fraction of a cord, wood measure. Ans. $\frac{17380}{221,184}$.

ADDITION OF VULGAR FRACTIONS.

CASE I.

To add fractions having common denominators.

RULE.—Add the numerators all together, divide the sum by the common denominator, the quotient is the answer.

EXAMPLES.

Add $\frac{9}{15}$, $\frac{10}{15}$, $\frac{6}{15}$, $\frac{\ }{15}$, $\frac{11}{15}$, $\frac{12}{15}$, $\frac{14}{15}$ together.

The numerators $9+10+6+5+11+12+14=67$

$67 \div 15 = 4\frac{7}{15}$ Ans.

CASE II.

To add fractions having different denominators.

RULE.—Find a common denominator by case 5th (in reduction,) use it as a dividend; use each given denominator as a divisor; divide, and multiply the quotients by the several numerators, and the sum of all the products is the numerator to the common denominator, and is the fraction required.

EXAMPLES.

1. Add $\frac{1}{2}$, $\frac{3}{5}$, $\frac{4}{6}$, $\frac{6}{8}$, $\frac{8}{10}$, $\frac{10}{12}$, $\frac{12}{14}$ together.

	denom.	*nume.*
Com. Den.	$840 \div 2 = 420 \times$	$1 = 420$
	$840 \div 5 = 168 \times$	$3 = 504$
	$840 \div 6 = 140 \times$	$4 = 560$
	$840 \div 8 = 105 \times$	$6 = 630$
	$840 \div 10 = 84 \times$	$8 = 672$
	$840 \div 12 = 70 \times$	$10 = 700$
	$840 \div 14 = 60 \times$	$12 = 720$

numerator 4206 $\frac{4206}{840}$ Ans.

2. It is required to add $\frac{9}{10}$, $\frac{7}{8}$, $\frac{13}{14}$, together.
Ans. $2\frac{148}{280}$.

3. It is required to add $\frac{1}{4}$, $\frac{6}{7}$, $\frac{8}{9}$, $\frac{10}{11}$, $\frac{11}{12}$, together. Ans. $4\frac{1892}{2772}$.

CASE III.

To add mixed numbers whose fractions have common denominators.

Rule.—Add the fractions as in case 1st; and the whole numbers as in Simple Addition; then add the sum of the fractions to the whole number.

EXAMPLES.

1. Required to add $104\frac{2}{20}$, $111\frac{16}{20}$, $96\frac{14}{20}$, $80\frac{16}{20}$.

whole num. $104+111+96+80=391$
num. of frac. $2+16+14+16=48 \div 20 = 2\frac{8}{20}$.

Ans. $393\frac{8}{20}$.

2. Required to add $14\frac{6}{13}$, $15\frac{2}{13}$, $18\frac{9}{13}$, $7\frac{10}{13}$, together. Ans. $56\frac{1}{13}$.

CASE IV.

To add mixed numbers whose fractions have different denominators.

RULE.—Add the fractions as in case second, and the whole numbers as in simple addition ; then add the sum of the fractions, to the sum of the whole numbers, and it is done.

EXAMPLES.

1. Add $12\frac{1}{2}$, $16\frac{2}{5}$, $17\frac{6}{8}$, $16\frac{10}{12}$, & $19\frac{7}{8}$ together.

Whole num. $12+16+17+16+19=80$
Sum of the fractions $3\frac{86}{240}$

Ans. $83\frac{86}{240}$

2. Add $21\frac{9}{10}$, $6\frac{7}{8}$, $127\frac{1}{2}$, & $14121\frac{1}{3}$ together. Ans. $14277\frac{73}{120}$.

CASE V.

To add fractions of several denominations, such as parts of cwts. ; parts of qrs. ; parts of lbs. &c.

RULE.—Find the value of each separate fraction by case tenth in reduction, and add the several sums together as in compound addition.

EXAMPLES.

1. Add $\frac{1}{2}$ of a cwt. $\frac{3}{4}$ of a qr. and $\frac{5}{6}$ of a lb. together.

	qr.	lb.	oz.	dr.
$\frac{1}{2}$ of a cwt. is	=2	0	0	0
$\frac{3}{4}$ of a qr. is	=0	21	0	0
$\frac{5}{6}$ of a lb. is	=0	00	13	$5\frac{1}{3}$
	2	21	13	$5\frac{1}{3}$ *Ans.*

SUBTRACTION OF VULGAR FRACTIONS.

CASE I.

To subtract simple fractions having common denominators.

RULE.—Subtract the least numerator from the largest, and the remainder placed over the common denominator will be the difference required.

EXAMPLES.

1. What is the difference between $\frac{12}{19}$ and $\frac{10}{19}$?

largest numerator 12
smallest numerator 10

2 difference $= \frac{2}{19}$ Ans.

2. What is the difference between $\frac{22}{41}$ and $\frac{15}{41}$? Ans. $\frac{7}{41}$.

3. What is the difference between $\frac{96}{212}$ and $\frac{74}{212}$? Ans. $\frac{22}{212}$.

CASE II.

To subtract a simple fraction, or a mixed number from a whole number.

RULE.—Subtract the numerator of the fraction from its denominator, and put the denominator of the fraction under the remainder; and carry one to be deducted from the whole number.

EXAMPLES.

1. It is required to subtract $\frac{3}{5}$ from 12.

$12 - \frac{3}{5} = 11\frac{2}{5}$ Ans.

2. It is required to subtract $27\frac{48}{57}$ from 32.

Ans. $4\frac{9}{57}$.

3. What is the difference between $12\frac{9}{10}$ and 21.

Ans. $8\frac{1}{10}$

4. What is the difference between 101 and $100\frac{99}{100}$.
Ans. $\frac{1}{100}$.

CASE III.

To subtract fractions having different denominators.

RULE.—Reduce the fractions to a common denominator, by case 5th in Reduction; and the difference of the numerators is the difference required.

EXAMPLES.

1 What is the difference between $\frac{19}{20}$ and $\frac{22}{45}$?

$\frac{19}{20}$ and $\frac{22}{45}$ are equal to $\frac{171}{180}$, $\frac{88}{180}$ dif. $\frac{83}{180}$ Ans.

2. What is the difference between $\frac{11}{15}$ and $\frac{9}{10}$? Ans. $\frac{5}{30}$.

CASE IV.

To distinguish the largest of any two fractions, &c.

RULE.—Reduce them to a common denominator, (by case 5th in reduction,) and the one that has the largest numerator is the largest fraction.

EXAMPLES.

1. Which is the greatest fraction $\frac{9}{10}$ or $\frac{11}{12}$?

$\frac{11}{12}$ reduced to a common denom. is equal to $\frac{55}{60}$

$\frac{9}{10}$ reduced to a common denom. is equal to $\frac{54}{60}$

Therefore $\frac{11}{12}$ is the largest fraction by $\frac{1}{60}$.

CASE V.

To subtract a mixed number from a mixed number, when the fraction which is to be subtracted is greater than the one which it is to be taken from.

RULE.—Reduce the fractions to a common denominator then subtract the numerator of the greater from

the common denominator, and to the remainder add the least numerator; and the sum of them must be set over the common denominator; and carry one to the whole number, and subtract the whole number as in simple subtraction.

EXAMPLES.

1. It is required to take $8\frac{12}{19}$ from $12\frac{3}{6}$.

$\frac{12}{19}$ reduced to a common denom. is equal to $\frac{72}{114}$

$\frac{3}{6}$ reduced to a common denom. is equal to $\frac{57}{114}$

$12\frac{57}{114}$ less by $8\frac{72}{114} = 3\frac{99}{114}$ Ans.

2. It is required to take $9\frac{16}{18}$ from $10\frac{1}{2}$.
Ans. $\frac{11}{18}$.

3. It is required to take $1\frac{7}{12}$ from $10\frac{3}{10}$.
Ans. $8\frac{43}{60}$.

CASE VI.

To subtract when the fractions are of different denominations; such as parts of cwt. qr. lb. &c.

Rule.—Find the value of the fraction (by case 10th in Reduction,) then subtract as in compound subtraction. If fractions happen in finding the value of the parts, reduce them to common denominators and subtract as in case third.

EXAMPLES.

1. It is required to take $\frac{9}{10}$ of a cwt. from $\frac{3}{4}$ of a ton.

	cwt.	*qr.*	*lb.*	*oz.*	*dr.*
$\frac{3}{4}$ of a ton=	15	0	0	0	0
$\frac{9}{10}$ of a cwt.=	0	3	16	12	$12\frac{8}{10}$
	14	0	11	3	$3\frac{2}{10}$ Ans.

2. Required to take $\frac{6}{18}$ of a cwt. from $12\frac{1}{2}$ cwt.
Ans. 12 cwt. 0 qrs. 18 lb. 10 oz. $10\frac{12}{18}$ dr.

MULTIPLICATION OF VULGAR FRACTIONS.

CASE I.

RULE.—Reduce compound fractions to simple ones; mixed numbers to improper fractions; then multiply the numerators all together for a new numerator, and the denominators for a new denominator.

EXAMPLES.

1. It is required to multiply $\frac{3}{8}$ by $\frac{2}{16}$ of $\frac{5}{6}$ of $\frac{1}{4}$.

$\frac{2}{16}$ of $\frac{5}{6}$ of $\frac{1}{4}=\frac{10}{384}\times\frac{3}{8}=\frac{30}{3072}=\frac{5}{512}$ Ans.

2. It is required to multiply $2\frac{3}{4}$ by $\frac{1}{2}$ of $\frac{6}{8}$. Ans. $\frac{66}{64}=1\frac{2}{64}$.

3. It is required to multiply $\frac{5}{12}$ by $\frac{9}{10}$. Ans. $\frac{45}{120}=\frac{3}{8}$.

4. It is required to multiply $\frac{1}{2}$ by $\frac{1}{3}$. Ans. $\frac{1}{6}$.

DIVISION OF VULGAR FRACTIONS.

RULE.—Reduce compound fractions to simple ones; mixed numbers to improper fractions; then invert the divisor (that is put the numerator for the denominator) and multiply the numerators together for a new numerator, and the denominators together for a new denominator; and the fraction thus found is the quotient required.

EXAMPLES.

1. It is required to divide $\frac{1}{3}$ by $\frac{6}{8}$.

$\frac{6}{8}$ inverted is $\frac{8}{6}\times\frac{1}{3}=\frac{8}{18}$ Ans.

2. It is required to divide $\frac{5}{1}$ by $\frac{7}{10}$. Ans. $7\frac{1}{7}$.

3. It is required to divide 10 by $\frac{1}{2}$ of $\frac{3}{5}$.

Ans. $33\frac{1}{3}$.

4. It is required to divide $10\frac{6}{7}$ by $7\frac{3}{10}$.

Ans. $1\frac{249}{511}$.

Miscellaneous Questions in Vulgar Fractions.

1. A school master being asked one day how many scholars he had, made answer that one fifth of them sat in one seat, one tenth on another, two fifths on another, two tenths on another, and 6 on another; I demand the number his school consisted of.

$\frac{1}{5}+\frac{1}{10}+\frac{2}{5}+\frac{2}{10}=\frac{9}{10}$ $10-9=1=\frac{10}{1}=$ of $\frac{9}{10}$ of $\frac{6}{1}=\frac{540}{10}=$ $54+6=60$. Ans.

2. A man, having returned from a journey, was asked by a friend, what his expenses were; the answer was, that he spent in Boston $\frac{2}{5}$ of his money; between Boston and New-York $\frac{1}{5}$; in New-York $\frac{1}{15}$; beyond New-York $\frac{1}{30}$; and he brought home \$40; I demand the sum he carried, and also what he spent.

Ans. carried \$160, and spent \$120.

RULE OF THREE IN VULGAR FRACTIONS.

RULE.—State the question as in the Rule of Three Direct, invert the divisor, and multiply the numerators together, and the denominators together, and the fraction thus found is the fourth term or answer; compound fractions must be reduced to simple ones, and mixed numbers to improper fractions.

EXAMPLES.

1. If $\frac{1}{2}$ bushel of corn cost $\frac{75}{100}$ of a dollar, what will $\frac{3}{4}$ of a bushel come to?

As $\frac{1}{2} : \frac{75}{100} :: \frac{3}{4}$ Dols.

$\frac{1}{2}$ inverted is $= \frac{2\times75\times3=450}{1\times100\times4=400} = 1\frac{1}{8}$ Ans.

2. If $10\frac{1}{4}$ bushels of potatoes cost $\$3\frac{1}{4}$, how many may be had for $\$12\frac{1}{2}$? Ans. $\frac{4100}{104}=39\frac{44}{104}$

3. If $\frac{1}{4}$ of $\frac{7}{8}$ of a ship is worth $\frac{5}{8}$ of 16000 dollars, how much is $\frac{1}{2}$ of $\frac{1}{5}$ of her worth?

Ans. $\$4571{\cdot}42{\cdot}8\frac{4}{7}$.

SIMPLE INTEREST.

DEFINITION.—Interest is a premium paid to the lender, by the borrower, for the use of money lent. Simple Interest is reckoned at 6 per cent. that is, at the rate of 6 dolls. for the use of 100 dolls. one year; and so in proportion to a longer, or shorter time, or for a smaller or larger sum.

Principal is the money lent.

Rate per cent. is the price agreed on.

The amount is the principal and interest together.

CASE I.

The principal and rate given to find the interest.

RULE.—Multiply the principal by the rate per cent. and that product by the number of years; the last product pointed, according to the rule of decimals, will be the answer for that time, in dollars and parts of a dollar.

EXAMPLES.

1. What is the interest of $22·16 cents for one year, at 6 per cent. per annum?

dolls. cts.	
22·16	principal.
·06	rate per cent.
1·3296	
1	time.

$1·3296=$1·32·9† Ans.

NOTE.—Six per cent. must be written ·06 and seven per cent. ·07, &c. this being observed, the rule of decimal fractions exactly applies.

2. What is the interest of $223·14 cts. for 5 years, at 6 per cent. per annum?

yrs. D. cts. m.

$223·14×·06=13·38 84×5=66·94·2† Ans.

3. What is the interest of 123 dols. 10 cts. 1 m. for 7 years, at 9 per cent. per annum? Ans. $77·55·3†

CASE II.

When the amount is required.

Rule.—Find the interest as in case first, and to it add the principal, the sum is the amount.

EXAMPLES.

1. What will $10·15 cts. amount to in 12 years, at 6 per cent. per annum?

```
$10·15
   ·06
------
 ·6090
    12
------
7·3080 interest.
10·15  principal added.
------
Ans. $17·4580 amount.
```

2. What is the amount of $1·12 cts. for 12 years, at 12 per cent. per annum? Ans. $2·73·2†.

3. What is the amount of $242·17 cts. for 3 years, at 9 per cent. per annum? Ans. $307·55·5†.

CASE III.

When there are years, months and days in the time.

Rule 1st. Reduce the days and months to the decimal of a year, then multiply the principal, rate, and time together, the product pointed for decimals according to rule will be the answer.

Rule 2d. Find the interest for the years by case first; for the months, divide a year's interest by the aliquot parts of a year; and for the days, divide a month's in-

terest by the aliquot parts of a month; the several quotients added with the interest for the years will be the answer.

EXAMPLES.

1. What is the interest of $6·22 cts. for 2 yrs. 6 mo. 10 days, at 6 per cent. per annum?

years	*mo.*	*days*	*years*		*D. cts.*				*cts. m.*	
2	6	10	= 2·527	×	6·22	×	·06	=	94·3†	Ans.

The same question by rule second.

$6·22 principal.
·06 rate.

6 mo. = ½ of a year. ½) ·3732 1 year's interest.
2

·7464 2 year's interest.
·1866 6 month's interest.
·0103† 10 day's interest.

Ans. ·9433† interest for 2 y. 6 mo. 10 d.

2. What is the interest of $10·10 cts. for 10 years, 11 months, at 9 per cent.?

years.	*mo.*	*years.*		*D.* *ct.*				*c.* *m.*	
10	11	= 10·916	×	10·10	×	·09	=	$9·92·2†	Ans.

The same question by rule second.

10·10
·09

6 mo. = ½ of 1 year. ½) ·9090 1 year's interest.
10

9·0900 10 year's interest.
3 = ½ of 6 mo. ½)0·4545 6 month's interest.
2 = ⅓ of 6 " ⅓)0·2272† 3 " "
0·1515 2 " "

$9·9232† Ans. *D. cts. m.* 9·92·3†

3. What is the interest of $213·13 cts. for 3 years, 12 days, at 10 per cent.? Ans. $64·67 cts. 9†m.

The same question by rule second.
Ans. $64·67 cts. 9†m.

4. What is the interest of $23·23 cts. for 1 year, 9 mo. at 6 per cent.? Ans. $2·43 cts. 9† m.

The same question by rule second.
Ans. $2·43 cts. 9†m.

5. What is the interest of $121·41 cts. for 2 years, 7 mo. at 5 per cent.? Ans. $15·64 cts. 3†m.

The same question by rule second.
Ans. $15·64 cts. 3†m.

Note.—In the preceding examples I have considered 30 days a month, and 12 months a year; which is the general method of casting interest; but by this meth od 5 days are lost in a year; $12\times30=360$ days; which in large sums would amount to something worthy of notice.

CASE IV.

To cast interest for any number of days; allowing three hundred sixty-five days to a year.

Rule.—Reduce the given number of days to the decimal of a year, which contain 365 days; then multiply the principal, rate, and time together, point off for decimals according to the rule of decimal fractions, and the product is the answer.

EXAMPLES.

1. What is the interest of $21·20 cts. for 27 days, at 9 per cent. per annum?

27 days is $\frac{27}{365}=\cdot0739$

$21·20 $\times$ ·09 $\times$ ·0739 = ·14 cts. 1† mill. Ans.

2. What is the interest of $12·06, for 3 yrs. 141 days at 6 per cent. per annum? Ans. $2·45†.

3. What is the interest of $3·03, for 136 days, at 6 per cent. per annum? Ans. ·06 cts. 7†m.

CASE V.

When the time is months, and the rate per cent. is six.

RULE.—Multiply the principal by half the number of months, (which is just equal to the rate for the time when the annual rate per cent. is six) if the months are odd, annex ·5 to the right hand, the product is the interest for the time.

EXAMPLES.

1. What is the interest of $21 for 10 months, at 6 per cent. per annum?

½)10 months=·05×$21=1·05 cts. Ans.

2. What is the interest of 250 dollars 11 cents, for 16 months, at 6 per cent. per annum?

Ans. $20·00 cts. 8†m.

3. What is the interest of $121·12 cents, for 21 months, at 6 per cent. per annum?

Ans. $12·71 cts. 7†m.

4. What is the interest of 9 dollars, 9 cents, for 9 months, at 6 per cent. per annum?

Ans. ·40 cts. 9† m.

CASE VI.

When the time is months and the rate any other than six.

RULE.—Find the rate for the time by proportion; say, as twelve months is to the rate per annum, so is the given number of months to the rate for the time.

EXAMPLES.

1. What is the interest of $26·21 cents for 8 months, at 9 per cent. per annum?

Months. Per cent. Months.

As 12 : 9 : : 8 : 6 the rate for that time.

$26·21×·06 rate $1·57·2 Ans.

2. What is the interest of $12·11 cents for 21 months, at 11 per cent. per annum? Ans. $2·33·1† m.

3. What is the interest of $111 for 13 months, at 10 per cent, per annum? Ans. $12·02·5.

4. What is the interest of $19 for 22 months, at 12 per cent. per annum? Ans. $4·18 cents.

CASE VII.

When endorsements are made on notes, &c.

RULE I.—Find the amount of the principal for the first year, and also the amount of the endorsements made in the same time; the difference between these sums is a new principal or balance due at that time; if the time is for more than a year, find the amount in the same way for every year.

RULE II.—A satute of Massachusetts establishes the following rule, when there are endorsements; find the interest on the principal to the first payment, add it to the principal, from the sum subtract the payment at that time made; if the endorsement is not equal to the interest at that time due, the interest is cast to the next endorsement, and the two endorsements are added, and their sum is subtracted; the remainder forms a new principal, interest on which must be cast to the next endorsement, &c. and thus proceed through the whole.

Examples by rule first.

1. Mr. Jenkins borrowed $1000 of Mr. Thorndike, and promised to pay it to him in one year, with lawful interest; but in six months after he paid $500; I demand what was due at the end of the year.

$1000 in 1 yr. amounts to $1060 amount of note.
$500 in 6 mo. amounts to 515 amount of endor.

Ans. $545 due.

The same question by rule second.

$1000 in 6 mo. amounts to $1030·00 cts.
endorsement subtracted 500·00

a new principal $530·00

$530·00 cts. in 6 mo. more amts. to $545·90 cts. due on settlement; 90 cts. more than by rule first.

Example second, by rule first.

2. Mr. Corridon borrowed $20000·00 cents of Mr. Cutler, and promised to refund the same in 1 year with simple interest; but it so happened that he paid $5000 of it in 3 months which was endorsed, and at the end of the year he paid the remainder; what was due on settlement?

Amount of $20000·00 in 1 year	$21200·00
Amount of endorsement in 9 mo.	5225·00
due on settlement. Ans.	$15975·00

The same question done by rule second.

Amount of $20000 in 3 months	$20300·00
endorsement subtracted	5000·00
new principal	$15300·00
Amount of new principal in 9 mo.	$15988·50

$13·50 cents more than by rule first.

Note I.—The reader will observe that the two methods do not agree, and the reason is obvious. In the first example by rule first Mr. Jenkins pays Mr. Therndike 500 dolls. six months before his note was due, and on settlement Mr. J. charges Mr. T. with the use of 500 dolls. six months, in addition to the sum then paid; (and I conceive it just and right, for he might have put the 500 dolls. to use, to some other person, and not have paid Mr. T. till his note was due; and then he certainly would have had the amount of 500 dolls. to have met Mr. T's demand, viz. 515,) and Mr. T. would have demanded of him 1000 dolls. and 1 year's interest; viz, $1060—$515=$545 due on settlement, same as by method first.

Note II.—By rule second the interest of 1000 dolls. is found for the first six mon. and added to the principal, and then the 500 dolls. is subtracted; and interest is cast on the remainder for the remaining six months; thus it is obvious that the 30 dolls. interest, that was added at the expiration of the first six months, absolutely became a part of the principal and carried interest the remaining six months; and of course makes the difference in the two methods.

$30×·06×6 months=·90 cents the difference as before.

Note III.—In the second question you will see that the difference in the two methods is 13 dolls. 50 cts.; and it is the interest of the 300 dollars interest, which was added at the expiration of the first three

months; which of course became a part of the principal, and bore interest the remaining nine months.

$300×·06×9 months=$13·50.

For my own part I cannot see any propriety in adding the interest to the principal, till one year has expired; and I do not see any injustice in the creditor's paying interest for the money received within a year, if the debtor pays him interest for all the money received of him, to the end of the year; therefore, I give my preference to the first method of operation.

CASE VIII.

An easy method of casting Interest for days, allowing 360 *days to a year.* 360 *divided by the rate per cent. will give a fixed divisor, which is* 60 *for* 6 *per cent.* 72 *for* 5 *per cent.* 90 *for* 4 *per cent.* 120 *for* 3 *per cent. and* 180 *for* 2 *per cent.*

RULE.—Multiply the principal by the days in the time, divide by 60 for 6 per cent. and the quotient will be cents: if dollars and cents are named in the sum, multiply and divide as above, and cut off two figures from the right of the quotient, the rest of the quotient is cents.

EXAMPLES.

1. What is the nterest of $72 for 90 days, at 6 per cent. per annum?

72×90=6400÷60=108 cts. or $1·08. Ans.

2. What is the interest of $1000 for 60 days, at 6 per cent per annum? Ans. 10·00.

3. What is the interest of $22·25 for 60 days, at 6 per cent per annum? Ans. ·22¼ cts.

4. What is the interest of $55·50 for 60 days, at 5 per cent.

55·50×60÷72=46|25 or ·46¼ cts. Ans.

5. What is the interest of $222·25 for 10 days at 6 per cent. per annum? Ans. ·37† cts.

A TABLE,

Shewing the amount of one dollar for any number of years under thirty-three; also the amount of one dollar for any number of months under twelve.

yrs.	amt.	yrs.	amt.	yrs.	amt.	mo.	amt.
1	$1·06	12	$1·72	23	$2·38	1	$1·005
2	1·12	13	1·78	24	2·44	2	1·01
3	1·18	14	1·84	25	2·50	3	1·015
4	1·24	15	1·90	26	2·56	4	1·02
5	1·30	16	1·96	27	2·62	5	1·025
6	1·36	17	2·02	28	2·68	6	1·03
7	1·42	18	2·08	29	2·74	7	1·035
8	1·48	19	2·14	30	2·80	8	1·04
9	1·54	20	2·20	31	2·86	9	1·045
10	1·60	21	2·26	32	2·92	10	1·05
11	1·66	22	2·32	33	2·98	11	1·055

Use of the preceding Table in casting Interest.

RULE.—Look in the table for the amount of 1 dollar for the given time, and multiply the principal by the tabular number, and the product is the amount required; if years and months are named in the time, multiply the principal by the tabular number for the years, to which add the interest for the months, the sum will be the amount.

EXAMPLES.

1. What will 16 dollars amount to in six years at 6 per cent?

$1 in 6 years amounts to $1·36×$16=$21·76 Ans.

2. What will 211 dollars amount to in 9 years at 6 per cent.? $324·94 Ans.

3. What will 25 dollars amount to in 10 months at 6 per cent.? $26·25 Ans.

4. What will 61 dollars amount to in 7 months at 6 per cent.? $63·135 Ans.

5. What will 22 dollars amount to in 8 months at 6 per cent.? $22·88 Ans.

6. What will 1 dollar amount to in 8 years, 6 months at 6 per cent? $1·51 Ans.

Simple Interest in Lawful Money.

Rule.—Multiply the principal by the rate per cent., and divide the product dy 100, the quotient is 1 year's interest; if months and days are mentioned in the time, find 1 year's interest as above, and divide it by the aliquot parts of a year, add the parts together, the sum will be the answer.

EXAMPLES.

1. What is the interest of £2 6 $7\frac{1}{2}$ for 1 year at 6 per cent.?

```
      £    s.   d.
      2    6    7½
                6
   ─────────────    £   s.   d.
100)13    19    9(0   2   9 47/100  Ans.
    20
   ────
100)279(2s.
    200
   ────
     79
     12
   ────
100)957(9d.
    900
   ────
     57
```

2. What is the interest of the same sum, viz. £2 6 $7\frac{1}{2}$ for one year, one month, ten days?

One year's interest, Fractions omitted.

```
1 month - - -  1/12)2  9
10 days - - -   1/3)0  2¾
                    0  0 11/12
                   ─────────
                    3  0 8/12  Ans.
```

3. What is the interest of £250 15s. for 3 years, one month at six per cent? Ans. £46 7 $9\frac{3}{10}$.

4. What is the interest of £59 10 for 3 years 6 mo. at 6 per cent.? Ans. £12 $9\frac{2}{10}$.

COMPOUND INTEREST.

DEFINITION.—Compound Interest is the interest of the interest; when interest is not paid yearly it ought to become a part of the principal.

RULE.—Find the interest of the principal for one year, and to the interest add the principal, this sum will be the principal for the second year; thus continue to add the last interest and last principal together, until you have found the amount for the number of years required; from the last amount subtract the first principal, and the remainder is the interest sought.

EXAMPLES.

1. What is the compound interest upon 100 dollars for 3 years, at 6 per cent. per annum?

100	1st principal.
.06	
6·00	1st interest.
100·	1st principal added.
106·00	2d principal.
·06	
6·3600	2d interest.
106.	2d principal added.
112·3600	3d principal.
·06	
6·741600	3d interest.
112·3600	3d principal added.
119·101600	3d amount.
100·000000	1st principal subtracted.
Ans. $19·1016	compound interest.

METHOD SECOND.

RULE.—Find what aliquot part the rate per cent. is of 100; divide the principal by the aliquot part, or parts,

and set the quotient, or quotients under the principal, the same as quotients in short division ;* add the quotients and principal together, the sum is the second principal; divide the second principal in the same manner, by the aliquot parts, &c. the sum of the quotients, &c. is the second principal; thus continue till you have found the amount required; from which subtract the first principal, the remainder is the interest sought.

TABLES OF ALIQUOT PARTS OF AN HUNDRED.

1 per cent. is $\frac{1}{100}$	5 per cent. is $\frac{1}{20}$
2 per cent. is $\frac{1}{50}$	10 per cent. is $\frac{1}{10}$
4 per cent. is $\frac{1}{25}$	20 per cent. is $\frac{1}{5}$

EXAMPLES.

1. What will 112 dollars amount to in 4 years, at 6 per cent. compound interest?

5 per cent. is equal to	$\frac{1}{20}$	112·00	
1 per cent. is equal to $\frac{1}{5}$ of 5.	$\frac{1}{5}$	5·60	1 year's int.
		1·12	
5 per cent. is equal to	$\frac{1}{20}$	118·72	1st amount.
1 per cent. is equal to $\frac{1}{5}$ of 5.	$\frac{1}{5}$	5·936	2d yrs. in.
		1·187†	
5 per cent. is equal to	$\frac{1}{20}$	125·843	2d amount.
1 per cent. is equal to $\frac{1}{5}$ of 5.	$\frac{1}{5}$	6·292	3d yrs. in.
		1·258†	
5 per cent. is equal to	$\frac{1}{20}$	133·393	3d amount.
1 per cent. is equal to $\frac{1}{5}$ of 5	$\frac{1}{5}$	6·669†	4th yrs. in.
		1·333†	

Amount $141·395 Ans.

*If the rate per cent, is no aliquot part of an hundred, use two, or more numbers that will make the rate per cent, and are aliquot parts of an hundred : divide by these numbers, add the quotients, the sum will be the answer.

2. What is the amount of $2·12 cents for 4 years, at 12 per cent. per annum? Ans. $3·33†.

3. What is the compound interest of $33·33 cents 2 years, at 10 per cent.? Ans. $6·99·9†.

4. What is the amount of 6·66 cents 2 years, at 9 per cent. per annum? Ans. $7·91·2†.

METHOD THIRD.

The third and easiest method is by the help of the following table, which shews the amount of one dollar for any number of years under 30, at 6 per cent. compound interest.

yrs.	*amt.*	*yrs.*	*amt.*	*yrs.*	*amt.*
1	$1·0600	11	$1·89829	21	$3·39956
2	1·12360	12	2·01219	22	3·60353
3	1·19101	13	2·13292	23	3·81975
4	1·26247	14	2·26090	24	4·04893
5	1·33822	15	2·39655	25	4·29187
6	1·41852	16	2·54035	26	4·54938
7	1·50363	17	2·69277	27	4·82234
8	1·59384	18	2·85434	28	5·11168
9	1·68948	19	3·02559	29	5·41838
10	1·79084	20	3·20713	30	5·74349

Use of the preceding table.

In the table find the amount of one dollar for the given time, and multiply the given principal by the amount of one dollar, the product is the answer.

EXAMPLES.

1. What will 50 dollars amount to in 6 years, at 6 per cent. compound interest?

$1 in 6 yrs. amounts to $1·41852 × 50 = $70·926 Ans.

2. What will 505 dollars amount to in 5 years, at 6 per cent. compound interest? $675·801† Ans.

3. What will $222·22 amount to in four years, at 6 per cent. compound interest? Ans. 280·546.†

SINGLE FELLOWSHIP.

Definition.—Single Fellowship teaches to find the gain or loss of each, of several persons, who have joined their stocks for an equal time in trade.

Rule.—As the sum of all their stocks is to the sum of gain or loss, so is each man's particular stock, to his particular share of the gain or loss.

Proof.—Add the several shares of gain or loss together, if the work is right, the sum will be equal to the sum of gain, or loss.

EXAMPLES.

1. A. B. C. and D. joined their stocks, and bought 367 barrels of beef which they sold at $2·75 cts. advance upon the barrel; A.'s stock was 562 dollars; B.'s 646 dollars; C.'s 394 dollars; and D.'s 600 dollars: I demand the share of each?

367 bar. at $2·75 cents=$1009·25 cents gained.

562 A.'s stock.
646 B.'s do.
394 C.'s do.
600 D.'s do.

		dols. cts.		dols.	dols. cts.	
As	2202 :	1009·25	: :	562 :	257·58$\frac{734}{2202}$	A.'s share.
	2202 :	1009·25	: :	646 :	296·08$\frac{734}{2202}$	B.'s do.
	2202 :	1009·25	: :	394 :	180·58$\frac{734}{2202}$	C.'s do.
	2202 :	1009·25	: :	600 :	275·00 -	D.'s do.
					1009·25 proof.	

2. Three men built a ship which cost 4560 dollars; $\frac{1}{4}$ of her belonged to A. : $\frac{2}{5}$ to B. : and the remainder to C.: they agreed to freight her with a cargo of lumber worth 1270 dollars, in proportion to their shares: and send her to the W. I. She was lost; I demand the loss of each.

Ans. A. lost $1457·5 : B. lost $2332 : C. lost $2040·5.

DOUBLE FELLOWSHIP.

Definition.—Double Fellowship teaches to find the shares of gain, or loss of several persons, who have joined their stocks in trade for unequal times.

Rule.—Multiply each man's stock by the time it was in trade; then say, as the sum of the products is to the gain or loss, so is the product of each man's stock and time, to his share of the gain or loss.

EXAMPLES.

1. A. commenced trade with a capital of 500 dollars; in 1 month after, he received B. as a partner, with a capital of 450 dollars; in three month's after this they received C. with a capital of 900 dollars; they traded 4 years from the time that A. commenced business, and gained 3420 dollars; I demand the gain of each?

	stock.	*mo.*		
A's stock multiplied by the time	500 ×	48 =	24000	A's.
B's stock multiplied by the time	450 ×	47 =	21150	B's.
C's stock multiplied by the time	900 ×	44 =	39600	C's.
		total amount	84750	

amt.	*dols.*		*dols. cts.*	
84750 :	3420 : :	24000 :	$968{\cdot}49\frac{47250}{84750}$	A's share.
84750 :	3420 : :	21150 :	$853{\cdot}48\frac{57000}{84750}$	B's do.
84750 :	3420 : :	39600 :	$1598{\cdot}01\frac{65250}{84750}$	C's do.

2. A. began trade with a capital of 1300 dollars; he traded 9 months and died: B. offered the family to continue the business, if they would allow his time to be equal to A's stock; and divide the gain accordingly; it was so agreed, and he continued business 1 year and three months from the death of A; I demand the shares of each, allowing the gain to have been 392 dollars.

A's capital 1300 dollars, and in trade 2 years. B's time valued \$1300, and in trade, 1 year and 3 months.

The heirs of A. had $\$241{\cdot}23\frac{3900}{50700}$.
B. $\$150{\cdot}76\frac{46800}{50700}$ Ans.

3. B. and D. joined stocks, viz. 500 dollars each; they traded 2 years, and B. took out one fifth of his stock, and they continued their trade 3 years longer, and gained 627 dollars; what is the share of each?

Ans. B's \$293·48$\frac{44}{47}$ D's \$333·51$\frac{3}{47}$.

PRACTICE.

Definition.—Practice is a rule which teaches to solve such questions by division, as are solved by compound multiplication or single rule of three; it is not so useful in the present currency of the United States as it was in the former currency; but in many instances it is still a short and easy way of finding the price of several things.

Table of aliquot parts of a Dollar.

1 cent	is $=\frac{1}{100}$ dol.	10 cents	is $=\frac{1}{10}$ dol.
2 "	is $=\frac{1}{50}$	20 "	is $=\frac{1}{5}$
4 "	is $=\frac{1}{25}$	50 "	is $=\frac{1}{2}$
5 "	is $=\frac{1}{20}$	25 "	is $=\frac{1}{4}$

Tables of aliquot parts of a Cwt. & qr.

1 qr.	is $=\frac{1}{4}$ cwt.	7 lb.	is $=\frac{1}{4}$ qr.
2 "	is $=\frac{1}{2}$ "	14 "	is $=\frac{1}{2}$ "

CASE I.

When the price is cents and the quantity whole numbers.

Rule.—Write down the quantity, as so many dollars, see what part, the cents in the price, is of a dollar, divide by that part, and the quotient is the answer.

EXAMPLES.

1. What will 622 yards of India cotton come to, at 25 cts. per yard? \$622 $\div \frac{1}{4}=$ \$155·50 Ans.

NOTE.—The quantity being written down as so many dols. I considered that 25 cts. were equal to $\frac{1}{4}$ of a dollar, therefore $\frac{1}{4}$ of the quantity is the answer.

2. What is the price of 3472 oranges at 5 cents a piece? Ans. $173·60 cts.

CASE II.

When the quantity is whole numbers and the price is dollars and cents.

RULE.—Multiply the quantity by the dollars in the price, and work for the cents as in case first.

EXAMPLES.

1. What will 22 thousand of boards come to, at 9 dollars 25 cents per thousand?

$$
\begin{array}{rl}
25\text{ cts.} = \frac{1}{4})22 & \text{quantity.} \\
9 & \\
\hline
198 & \\
5·50 & \\
\hline
\$203·50 & \text{Ans.}
\end{array}
$$

2. What will 20 barrels of cider come to at 2 dollars 16 cents per barrel? Ans. $43·20 cts.

CASE III.

When the price is no aliquot part of a dollar.

RULE.—Divide by two or more numbers, whose sum will make the number required.

EXAMPLES.

1. What will 622 yards of linen come to, at 30 cts. per yard?

$$
\begin{array}{rrl}
 & \text{dols.} & \\
20\text{ cts.} = \frac{1}{5}) & 622 & \\
\hline
10\text{ cts.} = \frac{1}{2}\text{ of }20.\ \frac{1}{2}) & 124·40\text{ cts.} & \text{price at 20 cts.} \\
 & 62·20 & \text{price at 10 cts.} \\
\hline
\text{Ans.} & \$186·60 & \text{price at 30 cts.}
\end{array}
$$

2. What will 642 yards of India cotton come to, at 17 cts. per yard?

	dols.	
2 cts. $=\frac{1}{50}$ }	642·00	
10 " $=\frac{1}{10}$ }		
	12·84	price at 2 cts.
5 " $=\frac{1}{2}$ of 10.	$\frac{1}{2}$)64·20	price at 10 cts.
	32·10	price at 5 cts.
Ans.	\$109·14	price at 17 cts.

CASE IV.

When there are several denominations in the quantity, and the price is dollars and cents.

RULE.—Multiply the dols. in the price into the whole numbers of the quantity; work for the cents in the price as in the preceding cases; and for the parts in the quantity divide by the aliquot parts of the price of one whole number add the quotients together the sum is the answer.

EXAMPLES.

1. What will 112 cwt. 3 qr. 14 lbs. of sugar come to, at 12 dols. 25 cts. per cwt.?

25 cts. $=\frac{1}{4}$)	112 cwt.	
	12 dols.	
	1344	price at 12 dols.
	28	price at 25 cts.
	\$1372	price of 112 cwt. at \$12·25.

For the parts in the quantity.

	dols.cts.	
3 qrs. $=\frac{3}{4}$)	12·25	
14 lbs. $=\frac{1}{6}$ of 3 qrs. $\frac{1}{6}$)	9·18†	price of 3 qrs.
	1·53	price of 14 lb.
	10·71	price of 3 qrs. 14 lb.
	1372·00	price of 112 cwt.
	\$1382·71†	Answer.

TARE AND TRET.

DEFINITION.—Tare and Tret are allowances made the buyer by the seller, for the weight of the box, cask, &c.

Tare is an allowance for the weight of the cask, and is generally at a certain rate per cwt. or per barrel, &c.

Tret is an allowance for the waste by dust, and is generally at the rate of 4 lb. per every 104 lb. &c.

Cloff is an allowance made the buyer for the turn of the scale, and is generally at 2 lb. per 3 cwt.

Gross is the whole weight of the goods, together with the cask, or box, &c. that contains them.

Suttle is when part of the allowance is deducted.

Neat is the remainder after all deductions are made.

CASE I.

When the tare is at a certain rate per hhd. &c.

RULE.—Multiply the tare per box, or hhd. by the number of boxes, &c. subtract the product from the gross weight, the remainder is the neat weight required.

EXAMPLES.

1. What is the neat weight of 3 hhd. of tobacco, weighing in all 13 cwt. 2 qr. 27 lb.; tare at 1 cwt. 1 qr. per hhd.?

cwt.	*qr.*	*lb.*	*cwt.*	*qr.*		*cwt.*	*qr.*	*lb.*	
13	2	27—	1	1×3=		9	3	27	*Ans.*

2. What is the neat weight of 910 bags of India sugar, each weighing 1 cwt. 2 qr. 20 lb.; tare at the rate of 15 lb. per bag?

Ans. 1405 cwt. 2 qr. 14 lb.

CASE II.

When the tare is at a certain rate per cwt.

RULE.—If the rate per cwt. is an aliquot part, divide the gross by the aliquot part, or parts, and the quotient, or quotients will be the tare of the whole, which must be subtracted from the gross; the remainder will be the neat weight required.

EXAMPLES.

1. What is the neat weight of 19 cwt. 3 qr. 26 lb. gross: tare at 2 qr. per cwt. ?

	cwt.	qr.	lb.	
2 qr. $=\frac{1}{2}$ of 1 cwt. $\frac{1}{2}$)	19	3	26	gross.
	9	3	27	tare subtract.
Ans.	9	3	27	neat.

2. What is the neat weight of 347 bags of sugar, each weighing 2 cwt. 3 qr. 12 lb.; tare at 21 lb. per bag? Ans. 926 cwt. 1 qr. 13 lb.

CASE III.

When the tare is at a certain rate per cwt. and is no aliquot part.

RULE.—Say by single proportion as 112 lb. is to the rate per cwt. so is the number of lbs. gross to the tare required: which being subtracted from the gross, the remainder is neat.

EXAMPLES.

1. What is the neat weight of 38 cwt. 0 qr. 4 lb. of tobacco; tare at 11 lb. per 112 lb. ?

cwt. *qr.* *lb.*
38 0 4 = 4260 pounds.

lb. *lb.* *lb.*
As 112 : 11 : : 4260 : $418\frac{44}{112}$ tare.

lb. *lb.* *lb.* *cwt.* *qr.* *lb.*
$4260-418\frac{44}{112}=3841\frac{68}{112}$ neat $=34$ 1 $5\frac{68}{112}$ Ans.

CASE IV.

When tare and tret are allowed.

RULE.—Find and subtract the tare, as in the preceding cases; the remainder is suttle; divide the suttle by 26 (N. B. $\frac{4}{104}=\frac{1}{26}$) The quotient is the tret, which subtract, and the remainder is the neat weight.

EXAMPLES.

1. What is the neat weight of 5 cwt. 2 qr. of allum; tare 12 lb. per cwt.; and tret 4 pounds per every 104?

cwt.	qrs.	lb.		lb.		lb.		lb.		lb.	
5	2	=616.	As	112	:	12	: :	616	:	66	tare.

and 616—66=550 suttle. 550÷26=21$\frac{4}{26}$ tret.

and 550—21$\frac{4}{26}$=528$\frac{22}{26}$ lb. neat.=4 cwt. 2 qr. 24$\frac{22}{26}$ lb. Ans.

2. What is the neat weight of 21 cwt. 1 qr. 26 lb. of rice; tare 15 lb. per cwt. and tret 4 lb. per 104.

Ans. 17 cwt. 3 qr. 15$\frac{1814}{2912}$ lb.

CASE V.

When tare, tret, and cloff are allowed.

RULE.—Find and subtract the tare and tret as in the preceding cases, and divide the remainder by 168, the quotient is cloff, which subtract, and the remainder is the neat weight sought.

EXAMPLES.

1. What is the neat weight of 10 cwt.; tare 14 lb. per cwt.; tret 4 lb. per 104; and cloff 2 lb. per every 3 cwt.?

10 Cwt.=1120 lbs.

$\frac{14}{112}=\frac{1}{8}$	1120	
	140	tare sub.
$\frac{4}{104}=\frac{1}{26}$	980	
	37†	tret sub.
$\frac{2}{336}=\frac{1}{168}$	943	
	5†	cloff sub.
	938	lbs. neat.=8 cwt. 1 qr. 14 lb. Ans.

2. What is the neat weight of 12 cwt. 2 qr.; tare 7 lb. per cwt.; tret 4 lb. per 104; cloff 2 lb. per 3 cwt.?

Ans. 11 cwt. 0 qr. 24† lb.

DISCOUNT.

DEFINITION.—Discount is a sum of money abated for the ready payment of money due at a future time.

CASE I.

RULE.—As the amount of 100 dollars for the time given is to 100 dollars; so is the given sum to its present worth: subtract the present worth from the given sum, the remainder is the discount.

EXAMPLES.

1. A. owes B. 1000 dollars payable in one year; A. offers to pay the ready money if B. will make discount at 6 per cent.; I demand the discount to be made.

dols. *dols.* *dols.* *dols.*
As 106 : 100 : : 1000 : 943·39$\frac{66}{106}$ present worth.
dols. *dols.* *dols.*
And 1000—943·39$\frac{66}{106}$=56·60$\frac{40}{106}$ discount Ans.

NOTE.—It is thought by many, that the interest of the sum for the time is the discount which ought to be made; but this is an error. I shall here observe if B. had discounted the interest of 1000 dollars for a year, the discount would have been 60 dollars; and he would have had but 940 dollars in ready money, which allow him to receive, and put at interest to a third person; and at the end of a year he would receive but $996·40 cents, for the 1000 dollars; therefore he receives $3·60 less, than he would have received of A. had it remained in his hands; but allow B. to receive $943·39$\frac{66}{106}$ cents of A. in ready money; and put it at interest to D. in one year it would amount to just 1000 dollars; Therefore by this rule neither party suffers any injury.

2. What discount must be made on 560 dollars due in 9 months; discount at 8 per cent. per annum?

Ans. $31·69 $\frac{86}{106}$ cts.

RULE II.

As the amount of 100 dollars for the time and rate per cent. is to the interest of 100 dollars for the time and at the rate per cent. so is the given sum to the discount to be made.

EXAMPLES.

1. What is the discount upon 1000 dollars due in a year; at 6 per cent. per annum?

	dols.		*dols.*		*dols.*		*dols. cts.*	
As	106	:	6	: :	1000	:	$56{\cdot}60\frac{40}{106}$	Ans.

2. What is the discount upon 560 dollars due 9 months hence; at 8 per cent. per annum?

Ans. $\$31{\cdot}69\frac{86}{106}$.

3. What is the discount upon 75 dollars due in 3 years; at 3 per cent. per annum?

Ans. $6{\cdot}19\frac{30}{109}$.

EQUATION OF PAYMENTS.

DEFINITION.—The use of this rule is to find a certain time to make a payment of several sums of money at once, due at several different times.

RULE.—Multiply each separate payment by the time when it would become due; add the several products together for a dividend; add the several separate payments together for a divisor; divide, and the quotient is the equated time.

EXAMPLES.

1. A. owes B. 100 dollars payable in 9 months; 72 dollars payable in 6 months: and 200 dollars payable in 22 months: in what time may A. pay all the notes at once, that neither party shall not be liable to suffer any harm?

First payment	$100\times$	9 mo.	=	900
second	do.	$72\times$ 6 mo.	=	432
third	do.	200×22 mo.	=	4400
		372 divisor.		5732 dividend.

$5732\div372=15$ mo. $12\frac{36}{372}$ days Ans.

2. C. owes D. 100 dollars on demand; 100 dollars in one year; 100 dollars in two years; 100 dollars in three years; what is the equated time to pay all at once?

Ans. $1\frac{1}{2}$ year.

ALIGATION MEDIAL.

DEFINITION.—Aligation Medial is a rule made use of, to find the price of a compound of several things mixed together; the prices of the ingredients and quantities being known.

RULE.—As the sum of all the quantities, is to the total value of all the quantities, so is any part of the mixture to the price of that part.

EXAMPLES.

1. A farmer mixes 4 bu. of blighted corn at ·42 cents per bu.; 6 bu. of oats at ·33 cents; 5 bu. of barley at ·96 cents; and 15 bu. of potatoes at ·20 cents per bu.; what is one bu. of the mixture worth?

	bu.		*cts.*		*D. cts.*
Corn	4	at	·42	=	1·68
Oats	6	"	·33	=	1·98
Barley	5	"	·96	=	4·80
Potatoes	15	"	·20	=	3·00

As 30 : $11·46 : : 1 : 38⅕ Ans.

2. A trader mixes 60 gal. of rum at ·90 cts. with 62 gal. at ·80 cts.; 40 gal. at ·45 cts.; and 10 gal. of water: what is 10 gal. worth? Ans. $7·06† cts.

3. A trader mixes 1 cwt. of sugar at 10 dollars per cwt. with 3 cwt. at 12 dollars, and adds 40 lbs. of sand to the mixture; what is the value of 1 cwt. of the mixture? Ans. $10·55†.

ALIGATION ALTERNATE.

DEFINITION.—Aligation Alternate is a rule made use of to find the quantity of any number of simples, whose prices are given, that will make a mixture worth a certain price, therefore it is the reverse of aligation medial, and may be proved thereby.

CASE I.

RULE.—Write down the prices of the several simples in a column, one above the other, beginning with the least, &c. on the left of the column draw a perpendicular line; and on the left of the line, write down the price of the mixed quantity; then connect with a curved line each of the simples which is less, with one that is greater than the mixed quantity; and set the difference between the least simple (and price of the mixed quantity) against the simple that is largest; and the difference of the larger against that which is less, &c. after having connected each simple that is less with one that is greater, and found the differences; the figures standing against each simple will express the quantity that must be taken of that price, to form a mixture of the price intended.

EXAMPLES.

1. A farmer would make a mixture of corn at ·50 cts; oats at ·25 cents; barley at ·90 cents; and potatoes at ·20 cents per bushel: I demand the quantity of each that must be taken that the mixture may be worth ·30 cents per bushel.

The price of the Mixture.			
cts. ·30	20	60 bushels of potatoes,	will make a mixture worth ·30 cts. per bu.
	25	20 bushels of oats,	
	50	5 bushels of corn,	
	90	10 bushels of barley,	

Proof by aligation medial.

Bushels 60×·20 cts.=$12·00
20×·25 cts.= 5·00
5×·50 cts.= 2·50
10×·90 cts.= 9·00

—— —— *bush. cts.*

As 95 : $28·50 : : 1 : ·30 Ans.

NOTE.—Questions in this rule admit of a great variety of answers, according to the manner of their being linked together, and yet the value of the mixture will be the same.

The first example linked another way.

The price of the mixture.			
cts. 30	20	20 bushels of potatoes,	will make
	25	60 bushels of oats,	a mixture
	50	10 bushels of corn,	worth ·30 cts.
	90	5 bushels of barley,	per bushel.

Proof by aligation medial.

Bushels 20×·20 cts. = $4·00
60×·25 cts. = 15·00
10×·50 cts. = 5·00
5×·90 cts. = 4·50

		bu.	cts.
As 95 :	$28·50 : :	1 :	·30 Ans.

2. A seller of wines would mix wine at ·90 cts. ·80 cts. ·70 cts. ·60 cts. and ·50 cts. per gallon; and take such a quantity of each, that the mixture may be worth ·85 cts. per gallon; I demand the quantity of each that may be taken.

This question admits of a variety of linkings.

The price of the mixture.				gal.	cts.
cts. ·85.	50	5		5 at	·50
	60	5		5 at	·60
	70	5	Ans.	5 at	·70
	80	5		5 at	·80
	90	35+25+15+5=		80 at	·90

CASE II.

When the mixture is limited to a certain quantity.

Rule.—Find a quantity that will compose a mixture by case first: then say as the sum of the quantities thus found, is to the limited quantity, so is each particular quantity found, to the part of that quantity.

EXAMPLES.

1. A seller of liquors would make a cask of cherry of 80 gallons: and would compose it of rum at ·50 cts. and ·90 cts. per gallon, and of water: I demand the quantity that must be taken, allowing the mixture to be worth ·60 cts. per gallon.

Note. This question admits of but one linking.

The price of the Mixture.			
cts.	00	30	30 gallons of water.
·60.	50	30	30 gallons of N. E. rum.
	90	60+10=70	70 gallons of W. I. rum.

	Galls.	*galls.*	*galls.*		
As	130 :	80 : :	30 :	$18\frac{60}{130}$ of water.	Ans.
	130 :	80 : :	30 :	$18\frac{60}{130}$ of N. E. rum.	
	130 :	80 : :	70 :	$43\frac{60}{130}$ of W. I. rum.	

CASE III.

When one of the simples is limited to a certain quantity.

Rule.—Find the quantities that will make a mixture by case first (the simple that is limited must be linked) then say, as the quantity that stands against the price of the limited quantity is to the other quantities taken separately, so is the limited quantity to the quantity of each.

EXAMPLES.

1. A grocer has 40 lbs. of tea worth ·30 cts. per lb. which he would mix with other teas at ·90, ·80, and ·70 cts. per lb.; what quantity of each must be taken that the mixture may be worth ·60 cts. per lb. ?

The price of the Mixture.			
cts.	30	30+20+10=60	Answers.
·60.	70	30	
	80	30	
	90	30	

	lbs.	*lbs.*	*lbs.*	*lbs.*		*lbs.*	*lbs.*	*Proof.*
As	60 :	30 : :	40 :	20	*Answers.*	20	× ·70=	$14·00
	60 :	30 : :	40 :	20		20	× ·80=	16·00
	60 :	30 : :	40 :	20		20	× ·90=	18·00
The limited quantity				40		40	× ·30=	12·00
						100 lbs.		$60·00

As 100 lb. : $60 : : 1 lb. : 60 cts. Ans.

EXTRACTION OF THE SQUARE ROOT.

DEFINITION.—Extracting the square root, is the finding of a number, which being multiplied into itself will produce the given number, or is finding the root of a square number.*

Roots	1,	2,	3,	4,	5,	6,	7,	8,	9.
Squares	1,	4,	9,	16,	25,	36,	49,	64,	81.

RULE.—Point the given number into periods of two figures each; beginning at the place of units, thus 134567: If the point happen to fall upon the last figure, it must be considered as a full period, thus 12345; secondly, having pointed the number into periods of two figures each; begin at the left hand, and find the greatest square that can be had in that period; place the root thereof in the quotient, and its square under the first period, subtract it therefrom, and to the remainder bring down the next period, and call it the resolvend; double the quotient or root, and use it for a divisor; divide the resolvend, omitting the right hand figure, and place the answer in the quotient, and also at the right of the last divisor; multiply the divisor by the figure last put on its right, (and in the quotient;) place the product under the resolvend, and subtract it therefrom, and to the remainder, bring down the next period; double the right hand figure of the last divisor, and use it for a new one; divide the resolvend as before, omitting its right hand figure; thus continue, until the periods are all brought down, the quotient is the root sought.

EXAMPLES.

1. The square root of 37491129 is required.

*A number is squared when it is multiplied into itself.

```
6×6= 36 greatest sqr.)37491129(6123 root or Ans.
                      36
                      ---
                  121)149
                      121
                      ----
                 1222)2811
                      2444
                      -----
                12243)36729
                      36729
                      -----
```

2. What is the square root of 8896451041?

Ans. 94321.

3. I demand the square root of 10201.

Ans. 101.

4. The square root of 36481 is required.

Ans. 191.

NOTE.—If a remainder is left after the periods are all brought down, annex periods of cyphers, and continue the operation to any exactness; the root thus found must be expressed decimally.

EXAMPLES.

1. The square root of 234321 is required.

Ans. 484·067†.

2. The square root of 345678 is required.

Ans. 587·94†.

3. The square root of 490023 is required.

Ans. 700·016†.

4 The square root of 9432410 is required.

Ans. 3071·22†.

5. The square root of 87643211 is required.

Ans. 9361·7†.

6. The square root of 67432345 is required.

Ans. 8211·7†.

7. The square root of 40000000 is required.

Ans. 6324·5†.

CASE II.

To extract the square root of whole numbers and decimals.

RULE.—Prepare the decimals by annexing cyphers (if occasion require) so that a dot may fall on units place of the whole numbers, then proceed as in case first.

EXAMPLES.

1. The square root of 1·4884 is required.

```
  1·4884(1·22 root Ans.
  1
  ---
 22)48
    44
    ---
242)484
    484
    ---
```

2. The square root of 12·123 is required.
   The decimal prepared 12·1230.
   Root 3·48† Ans.

3. The square root of 9·181 is required.
   Ans 3·03†.

4. The square root of 20·3331 is required.
   Ans. 4·509†.

5. The square root of 11·1111 is required.
   Ans. 3·3333†.

CASE III.

To extract the square root of Vulgar Fractions.

RULE.—Reduce compound fractions to simple ones, mixed numbers to improper fractions, and all to a common denominator, and also to its lowest terms: then extract the root of the numerator for a new numerator, and the root of the denominator for a new denominator.

NOTE.—If the fraction be a surd, that is such an one whose root can never exactly be found, reduce it to a decimal, and extract the root.

EXAMPLES.

1. The square root of $\frac{3844}{8649}$ is required.

$$\frac{3844}{8649} = \sqrt[2]{\frac{4}{9}} = \frac{2}{3} \text{ Ans.}$$

2. The square root of $\frac{486}{726}$ is required.

$$\frac{486}{726} = \sqrt[2]{\frac{81}{121}} = \frac{9}{11} \text{ Ans.}$$

3. The square root of $\frac{294}{1014}$ is required. $\frac{7}{13}$ Ans.

Square Root Applied.

CASE I.

To form a square from any number, and to know how many can be upon a side.

RULE.—The square root of the number given, will be the number upon the side of the square.

EXAMPLES.

1. It is required to lay out 25600 square rods of land in a square: I demand the side of the square that will contain the land..

$$\sqrt[2]{25600} = 160 \text{ rods on a side.}$$

2. A gentleman purchased 3025 tiles, for the purpose of paving a square yard: I demand the number that can be upon a side.

$$\sqrt[2]{3025} = 55 \text{ upon a side.}$$

3. A certain General commanded an army of 49284 men; and the better to secure his standard, he gave orders to form into a square body 4 feet distant: I demand the number of men upon a side; and also the quantity of land they occupied.

Ans. 222 men, occupy 17 acres 150$\frac{2259}{27225}$.

CASE II.

Square root applied in finding the diameters of circles by having the area given.

RULE.—Divide the area by ·7854, the square root of the quotient is the diameter.

EXAMPLES.

1. I demand the length of rope to be tied to a horse's neck that he may graze upon 7854 square feet of new feed every day, for 4 days; one end of the rope being each day fastened to the same stake.

First circle will contain	7854	sq. ft.
Second circle will contain	15708	sq. ft.
Third circle will contain	23562	sq. ft.
Fourth circle will contain	31416	sq. ft.

sq. ft. *diam.* *ft.*

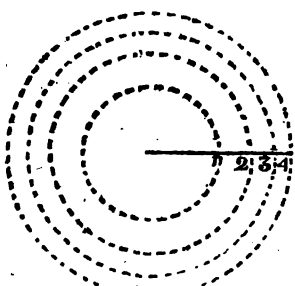
$7854 \div \cdot 7854 = \sqrt[2]{10000} = 100 \div \frac{1}{2} = 50$ first rope.

$15708 \div \cdot 7854 = \sqrt[2]{20000} = 141\dagger \div \frac{1}{2} = 70 \cdot 5$ sec. rope.

$23562 \div \cdot 7854 = \sqrt[2]{30000} = 173\dagger \div \frac{1}{2} = 86 \cdot 5$ third rope.

$31416 \div \cdot 7854 = \sqrt[2]{40000} = 200 \div \frac{1}{2} = 100$ fourth rope.

NOTE.—The following figure will serve to illustrate the idea; each ring in the figure contains an equal area, viz. ·7854 sq. ft.



The first day the horse will graze from the centre to 1; the second day to 2; the third day to 3; and the fourth day to 4; and will each day graze on the same quantity of new feed.

NOTE.—The diameter of a circle being given, the area is found by squaring the diameter, and multiplying its square by 7854.

2. A. B. C. and D. purchased a large grindstone, the diameter of which was 200 inches; they agreed that D. should wear off his share first, and that each man should have it alternately till they had worn off their shares; how much must each man wear off round the stone?

Ans. D. $13\frac{1}{2}$; C. 16; B. $20\frac{1}{2}$; A. 50 inches.

NOTE.—The preceding figure represents the grindstone, and the four rings each man's share in the same.

CASE III.

Square root applied in finding sides to triangles.

THEOREM FIRST.

The base and perpendicular given to find the hypothenuse.

RULE.—Square the base and perpendicular, add the two squares together, extract the root of their sum; the root is the hypothenuse.

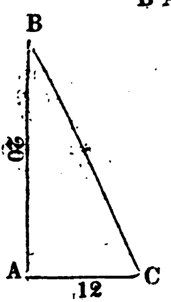
EXAMPLES.

1. A man wishes to make a ladder, that will reach from the eaves of his house, to the ground, 12 feet from the house; the eaves of the house are 20 feet from the ground; I demand the length of the ladder.

B A and A C given to find B C.

$20 \times 20 = 400$
$12 \times 12 = 144$ ft.

$\sqrt{544} = 23.3$† B. C. Ans.



THEOREM SECOND.

The base and hypothenuse given to find the perpendicular.

RULE.—Square the base and hypothenuse; subtract the least from the greatest; extract the root of the remainder; the root is the answer, or perpendicular.

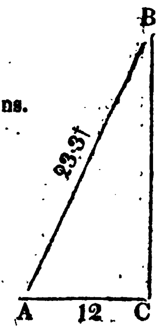
EXAMPLES.

1. What is the height of the eaves of a house that requires a ladder 23·3† feet long to reach from the ground to the same; allowing the bottom of the ladder to stand 12 feet from the bottom of the house?

A B and A C given to find C B.

A B 23·3 × 23·3 = 542·89†
A C 12 × 12 = 144·

ft. ft.
$\sqrt[2]{398·89}$ = 19·9†, or 20 Ans.



THEOREM THIRD.

The hypothenuse and perpendicular given, to find the base.

RULE.—Square the hypothenuse and perpendicular, subtract the less from the greater, extract the root of the remainder: the root is the answer, or base.

EXAMPLE.

1. Hypothenuse 23·3†; perpendicular 20; required the base. Ans. 11·9†, or 12 ft.

CUBE ROOT.

DEFINITION.—A cube is the third power of any number; *that is*, any number multiplied by itself, and that product again by the same number, produces a Cube; thus 9 × 9 = 81 × 9 = 729 is a cube; and 9 is the root.

EXTRACTION OF THE CUBE ROOT.

The extraction of the cube root is the finding of a number which has been multiplied three times by itself.

Rule.—Separate the number into periods of three figures each, beginning in units place; thus, $94\dot{3}21\dot{3}42\dot{7}$; find the greatest cube in the first period, place the root in the quotient, and its cube under the first period; subtract it therefrom, and to the remainder bring down the next period, which call the dividend, or resolvend; find a divisor by multiplying the square of the quotient by 300, seek how many times the divisor is contained in the resolvend, and put the answer in the quotient.

To find the subtrahend.

Multiply the divisor by the last quotient figure, and place the product under the last dividend (units under units &c.): then square the last quotient figure, and multiply the square by the preceding figures in the quotient, and the last product multiply by 30, and place this product also under the dividend (units under units, &c.): then cube the last quotient figure, and place its cube under the dividend also (units under units, &c.) add the three numbers (which have placed under the dividend) together, and subtract their sum from the last dividend; and to the remainder bring down the next period of figures, and proceed as before, until all have been brought down, and the quotient is the root.

Proof.—Cube the quotient, or root, add in the remainder (if there is any) and the sum will be like the given cube if the work is right.

EXAMPLES.

1. The cube root of 33076161 is required.

$3\times3\times3=27$)33076161(321 root Ans.
27

1st Divis. $3\times3\times300=2700$)6076 1st divid. or resolvend.

5400	2700×2	$=5400$
360	$2\times2\times3\times30$	$=360$
8	$2\times2\times2$	$=8$
5768 the 1st subtrahend		5768

2d Di. $32\times32\times300=307200$)308161 second dividend.

307200	307200×1	$=307200$
960	$1\times1\times32\times30$	$=960$
1	$1\times1\times1$	$=1$
308161 second subtra.		308161

NOTE.—In the above example I first found the greatest cube that was in the first period, viz. 27 and its root was 3, which I put in the quotient, and the cube I put under the first period, and subtracted it therefrom; and to the remainder (6) I brought down the next period of figures, viz. 076; which completed my first dividend or resolvend. Then for the first divisor, I squared the quotient or root, and multiplied the square by 300, which gave me 2700 for the first divisor; I found my divisor was contained in the dividend but twice, which I put in the quotient. Then for the subtrahend I multiplied my last divisor, viz. 2700, by the last figure in the quotient, viz. 2, which product I put under the last dividend; and I also squared the last figure in the quotient, viz. 2, and multiplied its square by the preceding figure in the quotient, viz. 3, and that product again by 30 and put this last product under the dividend; I then cubed the last figure in the quotient, viz. 2, and put its cube also under the dividend: I then found the sum of the three last numbers (standing under the dividend) and subtracted their sum from the dividend; and to the remainder, viz. 308, I brought down the next and last period, viz. 161, and proceeded as before.

2. The cube root of 1728000 is required.
Ans. 120.

3. The cube root of 997002999 is required.
Ans. 999.

4. The cube root of 367061696 is required.
Ans. 716.

NOTE.—When there is a remainder after the periods of figures are brought down, annex periods of cyphers (three at once) and point the root for decimals, and proceed as far as you please in decimals; or you may find a denominator to the remainder by the following *Rule.* viz. Square the root and multiply the square by 3; then multiply the root by 3; add the two products together, and their sum is a denominator to the remainder, which fraction must be annexed to the root to make it complete.

CASE II.

When there are decimals annexed to integers.

RULE.—Prepare the decimals that a point may fall upon units in the integers, then proceed as in case first.

EXAMPLES.

1. The cube root of 1780·360128 is required.
Ans. 12·12.
2. The cube root of 1815·848 is required.
Ans. 12·2.
3. The cube root of 1·442897 is required.
Ans. 1·13.

CASE III.

To extract the cube root of a vulgar fraction.

RULE.—Extract the root of the numerator, for a new numerator; and the root of the denominator for a new denominator; if the fraction be a surd, that is, one whose root cannot exactly be found, reduce it to a decimal and extract the root.

EXAMPLES.

1. The cube root of $\frac{1331}{1728}$ is required.
$\sqrt[3]{\frac{1331}{1728}} = \frac{11}{12}$ Ans.
2. The cube root of $\frac{729}{1000}$ is required. Ans. $\frac{9}{10}$.

CASE IV.

To extract the Cube Root of mixed numbers.

RULE.—Reduce the vulgar fractions to a decimal, annex it to the integers, and proceed as in case second.

Cube Root Applied.

CASE I.

Cube root applied in finding the solidity of globular figures, by having the diameter and solidity of one given.

Rule.—Globes are in proportion to one another as the cubes of their diameters; therefore cube the diameter of the given globe, and also of the required globe; and then say as the cube of the diameter of the given globe, is to its solidity, so is the cube of the diameter of the required globe to its solidity.

EXAMPLES.

1. If a cannon ball 6 inches in diameter weighs 25 lb. I demand the weight of another of the like metal, whose diameter is 3 inches.

$6\times6\times6=216$ the cube of the given diameter.
$3\times3\times3=\ 27$ the cube of the required diameter.
As 216 : 25lb. : : 27lb. : 3·12†lb. Ans.

2. If a ball of silver 12 inches in diameter is worth $600; I demand the value of another ball, whose diameter is 15 inches. $1171·87† Ans.

CASE II.

Having one side of a cubical figure given, to find the side of another, that will contain 2, 3, 4, 5, or 6 times as much as the given one.

Rule.—Cube the given side, then multiply the cube by the number mentioned in the question, (if three times as large, multiply by 3, &c.) the cube root of the product will be the side required.

Note.—If it is required to make one which is 2, 3, 4, 5 or 6, &c. times less than the given one: divide the cube of the given side by the number mentioned in the question, and extract the root of the quotient; the root is the answer sought.

EXAMPLES.

1. There is a box that is 3 feet high, 3 feet long, and 3 feet wide; I demand the side of another which shall contain 4 times the quantity.

feet.

$3\times3\times3=27\times4.=\sqrt[3]{108}=4\cdot7$ nearly Ans.

2. There is a box that is 4 feet wide, 4 feet high and 4 feet long; I demand the side of another that shall contain $\frac{1}{8}$ of the quantity. Ans. 2 feet.

PROBLEM III.

To find the side of a cubical box that shall contain a quantity equal to any given solidity.

RULE.—The cube root of the given solidity is the side of a box that will contain the same quantity.

EXAMPLES.

1. There is a cylindrical cistern that contains 3204 solid inches; I demand the side of a cubical box, that shall contain the same quantity.

$\sqrt[3]{3204}=14\cdot74$† in. Ans.

2. The side of a cubical cistern, that shall hold just as much liquor as a cask whose solid content is 25519·1196 inches, is required.

$\sqrt[3]{25519\cdot1196}=29\cdot44$† in. Ans.

REDUCTION OF COINS.

The former currency of New-Hampshire, Vermont, Massachusetts, Connecticut, and Rhode-Island reduced to dollars, cents, &c.

When the sum to be reduced is pounds only.

RULE.—Annex a cypher to the pounds, divide by 3, the quotient is dollars; if there is a remainder, annex

three cyphers, continue dividing, the quotient will be dimes, cents, and mills; 6 shillings is equal to $\frac{6}{20}=\frac{3}{10}$ $£1\times10\div3=3{\cdot}333$.

EXAMPLES.

1. It is required to reduce 621 pounds, into dollars, &c.
$6210\div3=\$2070$ Ans.

2. It is required to reduce £.19 into dollars, dimes, cents and mills. $£.190{\cdot}000\div3=\$63{\cdot}333$† Ans.

3. It is required to reduce £.121 to dollars, dimes, cents, &c. Ans. \$403·333†.

4. It is required to reduce £.16 to dollars, dimes, cents, &c. Ans. \$53·333†.

When the sum to be reduced consists of pounds, shillings, pence and farthings.

RULE.—To the pounds annex half the number of shillings, and two cyphers in decimals, if the shillings are even; if they are odd, annex the greatest even half, and 5 tenths and one cypher in decimals; if there are pence and farthings in the sum, reduce the pence to farthings, observing to increase the sum by 1 if it exceed 12, and by 2 if it exceed 37; add the farthings, thus increased, in the place of tenths and hundredths, divide the whole by 3, the quotient is cents.

EXAMPLES.

1. Reduce £3 10*s*. 11½*d*. to dollars, cents and mills.

$$\begin{array}{r} 35{\cdot}00 \\ {\cdot}48 \\ \hline \end{array}$$

$35{\cdot}48\div3=\$11{\cdot}826$† Ans.

2. Reduce £17 19*s*. 11¾*d*. to dollars, cents, and mills.

$$\begin{array}{r} 179{\cdot}50 \\ {\cdot}49 \\ \hline \end{array}$$

$179{\cdot}99\div3=\$59{\cdot}999$† Ans.

To change dollars, cents, &c. to the former currency of New-Hampshire, Vermont, Massachusetts, Rhode-Island and Connecticut.

Rule.—When the sum to be reduced is dollars; multiply the dollars by 3; double the right hand figure of the product for shillings; the remaining figures are pounds. If the sum to be reduced is dols. cts. and mills, multiply the whole by 3, point off 4 figures from the right for decimals; the rest of the product is pounds; (note, if mills are not named in the sum, three figures only must be pointed off;) find the value of the decimal part by multiplying by 20, 12 and 4; observing to point off for decimals each time of multiplying; and the sums standing on the left of the separatrix will be shillings, pence and farthings.

EXAMPLES.

1. It is required to reduce $251 to lawful money.
251 × 3=£75 6*s*. Ans.
2. It is required to reduce $9529 to lawful money.
9529 × 3=£2858 14*s*. Ans.
3. It is required to reduce $192 to lawful money.
192 × 3=£57 12*s*. Ans.
4. It is required to reduce $999 to lawful money.
£299 14*s*. Ans.
5. It is required to reduce $99·67 cts. to lawful money.

```
 99·67
     3
 -----
29·901
    20
 -----
18·020
    12
 -----
 ·240   29l. 18s. ¼d. Ans.
```

6. It is required to reduce $67·90 to lawful money.
Ans. 20*l.* 7*s.* 4¼*d.*

7. It is required to reduce $99·999 to lawful money.
Ans. 29*l.* 19*s.* 11¾†*d.*

8. It is required to reduce $61·276 to lawful money.
Ans. 18*l.* 7*s.* 7¾†*d.*

To reduce the former currency of New-York and North Carolina to dols. cts. &c. and the contrary.

Rule.—Prepare the sum to be reduced exactly as in New-Hampshire, Massachusetts, &c. and divide by 4 instead of 3, the quotient is cents; a dollar in New-York is equal to 8*s.* $\frac{8}{20}=\frac{4}{10}$ £1 × 10 ÷ 4 = $2·50.

EXAMPLES.

1 Reduce £9 16*s.* to dollars, and cents, &c.
98 ÷ 4 = $24·50 Ans.

2. Reduce £230 10*s* to dollars, and cents, &c.
2305 ÷ 4 = $576·25 Ans.

3. Reduce £219 15*s.* 4¼*d.* to dollars, cents, &c.

2197·50
·18
————
2197·68 ÷ 4 = $549·42 Ans.

4. A merchant in Boston purchased 1200 barrels of flour in New-York at £2 10 *s.* per barrel; paid freight at 33 cts. per barrel; what does it stand him at?
Ans. $7896.

5. Reduce £419 10*s.* to dollars, cents, &c.
$1048·75 Ans.

Change dollars, &c. to New-York and North-Carolina Currency.

Rule.—Proceed as in New-Hampshire currency, &c. only multiply by 4 instead of 3; the value of a dollar is equal to four tenths of a pound.

EXAMPLES.

1. Change 842 dols. to New-York currency, &c.

842
4

£336 16*s*. Ans.

2. Change $114·25 to North-Carolina currency, &c. Ans. £45 14*s*.

New-Jersey, Delaware, Pennsylvania, and Maryland currencies reduced to the present currency of the United States, and the contrary.

RULE.—Multiply the given sum (if it is pounds only,) by 8, and divide the product by 3; the quotient is dollars. If the sum is pounds, shillings and pence, reduce the whole to pence, and add one ninth of the whole to itself, the sum will be cents; a dollar in these states is equal to 7*s*. 6*d*., or $\frac{3}{8}$ of a pound. 7*s*. 6*d*=90*d*. $\frac{90}{240}=\frac{3}{8}$. £1×8÷3=$2·666.

EXAMPLES.

1. It is required to reduce £942 to dollars, &c.

942
8

3)7536

$2512 Ans.

2. It is required to reduce £961 19*s*. 6*d*. to dollars, &c. Ans. $2565·31 cts.

Reduce dollars, &c. to the former currency of New-Jersey, Delaware, Pennsylvania and Maryland.

RULE.—If the sum is dollars only, multiply by 3, and divide by 8, the quotient is pounds; if the sum is dollars and cents, subtract one tenth of the whole sum from itself, the remainder is pence.

EXAMPLES.

1. Reduce 628 dollars to Delaware currency, &c.

$628 \times 3 \div 8 = £235$ 10*s*. Ans.

2. Reduce 2512 dollars to New-Jersey currency.

Ans. £942.

3. Reduce \$2565·20 to Maryland currency, &c.

$\frac{1}{10}$)2565·20
256·52 subtract.

12)230868

20)19239

£961 19*s*. Ans.

A merchant of Portsmouth purchased 540 barrels of beef at \$12·50 per barrel, and sent it to Philadelphia and sold it there for £5 10*s*. per barrel; deducted the freight at 30 cts. per barrel, and laid out the remainder of the money in flour, at £3 10*s*. per barrel, and sent it to Portsmouth, and paid 30 cts. per barrel freight; and sold the flour in Portsmouth for $11\frac{1}{4}$ dollars per barrel; how much flour did he purchase, and did he gain or lose by the bargain, and how much? Ans.

Purchased 831 $\frac{3}{14}$ bar. flour.
Gained \$2351·79 $\frac{2}{14}$.

South Carolina and Georgia currency reduced to dols. cts. and the contrary.

RULE.—If the sum to be reduced is pounds, multiply by 30, and divide by 7, the quotient is dollars; (a dollar in South Carolina is equal to 4*s*. 8*d*. or seven thirtieths of a pound); if there are shillings and pence, &c. reduce the whole to pence, annex two cyphers and divide by 56, the quotient is cents. 4*s*. 8*d*.$=56d.=\frac{56}{240}=\frac{7}{30}$; £1 $\times 30 \div 7 = \$4{\cdot}28\frac{4}{7}$.

EXAMPLES.

1. It is required to reduce £56 to dollars &c.

```
   56
   30
 ------
 7)1680
 ------
  $240 Ans.
```

2. It is required to reduce £21 to dollars, &c.

Ans. $90.

3. Reduce £22 9*s.* 4*d.* to dollars, &c.

Ans. $96·28¼.

Dollars, &c. reduced to Georgia and South-Carolina currency.

RULE.—Multiply dollars by 7, and divide by 30, the quotient is pounds; if there are cents in the sum, multiply by 56, reject two figures from the right of the product, the rest of the figures are pence.

EXAMPLES.

1. Reduce $240 to Georgia currency, &c.

$240 \times 7 \div 30 = £56$ Ans.

2. Reduce $90 to South Carolina currency, &c.

$90 \times 7 \div 30 = £21$ Ans.

3. Reduce $96·28¼ to Georgia currency.

```
     96·28¼
        56
    -------
     57768
    48140
        32
    -------
 12)5392·00
    -------
```

449*s.* 4*d.* = £22 9*s.* 4*d.* Ans.

To reduce Canada and Nova Scotia currency to the present currency of the United States, and the contrary.

RULE.—When the sum to be reduced is pounds, multiply by 4, the product is dollars, (1 dol. is equal to 5 shillings in Canada, &c.); if shillings and pence are in the sum, reduce the whole to pence, annex 2 cyphers, and divide by 60, (note, 60 pence are equal to a dol.) the quotient is cents. $\frac{5}{20}=\frac{1}{4}$.

EXAMPLES.

1. Reduce £108 to dollars. $108\times4=\$432$ Ans.
2. Reduce £121 to dollars. $121\times4=\$484$ Ans.
3. Reduce £1057 5s. Canada currency, to dollars, &c.

$$\begin{array}{r} 1057\ 5 \\ 20 \\ \hline 21145 \\ 12 \\ \hline 253740{\cdot}00\div60=\$4229{\cdot}00 \text{ Ans.} \end{array}$$

Dollars, &c. reduced to the currency of Canada and Nova Scotia.

RULE.—If the sum to be reduced is dollars, divide them by 4, the quotient is pounds; if there are dollars and cts. multiply by 60, rejecting two figures on the right, the product is pence.

EXAMPLES.

1. Reduce \$432 to Canada currency, &c.
   $432\div4=£108$ Ans.
2. Reduce \$484 to Canada currency, &c.
   $484\div4=£121$ Ans.
3. Reduce \$4229·20 to Canada currency, &c.

```
    422920
        60
  ---------
12)253752|00
  ---------
     21146÷20=£1057 6s. Ans.
```

The present currency of England reduced to the present currency of the United States.

*When the sum is pounds only.**

Rule.—Multiply the pounds by 4·44 and point off 2 figures from the right, for cents, the rest are dollars.

EXAMPLES.

1. Reduce £16 sterling to dollars.
$16\times4{\cdot}44=\$71{\cdot}04$ cts. Ans.
2. Reduce 223 pounds sterling to dols. &c.
Ans. $990·12.

If the sum consists of pounds and shillings.

Rule.—To the pounds annex half the number of shillings, in the place of tenths; multiply the whole by 4·44, and point off three figures from the right, for cents and mills, the rest are dollars: If the shillings are odd, annex the greatest even half and for the odd shilling annex 5 in the place of hundredths, multiply by 4·44, and point off 4 figures for cents, &c. the rest are dollars,

EXAMPLES.

1. Reduce £19 19s. to dollars, &c.
$19{\cdot}95\times4{\cdot}44=\$88{\cdot}5780$ Ans.
2. Reduce £127 16s. to dollars, &c.
Ans. $567·432.

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* In England, accounts are kept in pounds, shillings, pence, and farthings, sterlings; 4 farthings make 1 penny; 12 pence 1 shilling; 20 shillings 1 pound, sterling.

PART SECOND.

MENSURATION

OF

PLANES AND SOLIDS.

DUODECIMALS, OR CROSS MULTIPLICATION.

DEFINITION.—Duodecimals is a rule used much in the mensuration of superficies and solids; and teaches to multiply feet and inches, by feet and inches without reducing. Inches are called primes and are marked thus ($'$); inches are divided into twelfths, or seconds, and marked thus ($''$); thirds, or the twelfth part of a second is marked thus ($'''$); thus all denominations less than a foot decrease in a twelve fold proportion and are designated by these characters, inches ($'$), seconds ($''$), thirds ($'''$), fourths, ($''''$), fifths ($'''''$), &c.

RULE.—Write down the number to be multiplied, in feet and primes, or inches, &c. and under it write down the number to multiply by; observing to write every denomination under that of the same name; multiply the highest denomination of the multiplier into all the denominations of the multiplicand, beginning with the lowest, observing to set down all over twelve, and carry the twelves to the next highest denomination; continue to multiply by every denomination of the multiplier, observing to remove the products as many places to the right, as the number you are multiplying by stands to the right of the highest; add up the products in the same order in which they stand, carry one for every twelve, the sum is the answer or product required.

EXAMPLES.

1. It is required to multiply 12ft. 9in. by 6ft. 4in.

ft.	in.	
12	9	
6	4	
76	6′	
4	3	0″
80	9	0 Ans.

NOTE.—In this example the highest denomination of the multiplier, *viz.* 6 feet, was multiplied into the lowest denomination of the multiplicand, *viz.* 9 inches; and the product was 54′, in which was 4 of the next denomination, *viz.* 4 twelves, and 6 left, which was set down, and the 4 was carried to the next denomination; I then multiplied the 6 feet into the 12 feet, and added the 4 to the product, and set the whole down; I then multiplied the 4 inches into the 9 inches, (removing the product one place to the right) and found the product to be 36; three twelves, none over; I then multiplied the 4 in. into the 12 ft. and added in the 3 I carried, which made 51, which was 4 twelves and 3 over; I then added the products together, the sum is the product required.

2. It is required to multiply 3ft, 2′ 3″ by 3ft, 2′ 3″.
Ans. 10ft. 1′ 11″ 0‴ 9⁗.

METHOD SECOND.

RULE.—Multiply the highest denomination in the multiplier into all the denominations of the multiplicand, and set down the whole products, &c. then multiply the next highest denomination in the multiplier into all the denominations of the multiplicand, and remove the products one place to the right, and set them all down; proceed thus through all the denominations, observing to set down the whole products each time of multiplying; then add up the several products in the order in which they stand, and carry the same as in Compound Addition, the sum will be the product required.

EXAMPLES.

1. What is the product of 12 ft. 9 in. multiplied by 6 ft. 4 in.

	ft.	in.	
	12	9	
	6	4	
	72	54	
		48	36''
pro.	80	9	0 Ans.

2. What is the product of 3 ft. 2' 3'' multiplied by 3 ft. 2' 3''?

	ft.	'	''		
	3	2	3		
	3	2	3		
	9	6	9		
		6	4	6'''	
			9	6	9''''
pro.	10	1	11	0	9 Ans.

3. What is the product of 12 ft. 11 in. 11 sec. multiplied by 12 ft. 11 in. 11 sec.

Ans. 168 ft. 9' 10'' 0''' 1''''.

NOTE.—This method need not be confined to 12, as some imagine, but may be extended to any denomination, as rods, yards, feet, and inches, &c.

EXAMPLES.

1. Required to multiply 22 yds. 2 ft. 11 in. by 7 yds. 2 ft. 2 in.

yds.	ft.	in.		
22	2	11		
7	2	2		
154	14	77		
	44	4	22''	
		44	4	22'''
176	2	7	3	10 Ans.

2. It is required to multiply 10 rods, 20 links, by 12 rods and 20 links, allowing 25 links to a rod.

Ans. 138 rods, 6 links.

NOTE.—In the last example I multiplied 12 rods by 20 links and set down the product, viz. 240; I then multiplied the 12 rds. by the 10 rds. and set down the product, viz. 120; I then multiplied the 20 lin. by the 20 lin. and removed the product one place to the right and set it down, viz. 400; I then multiplied 20 lin. by 10 rds. and set down the product, viz. 200; I then added the products together and carried by 25.

3. It is required to multiply 7 ft. 3 in. by 3 ft. 3 in.

Ans. 23 ft. 6′ 9″ $=23\frac{9}{16}$ ft.

NOTE.—The 6 inches are $=\frac{6}{12}$ and the 9″ $=\frac{9}{144}$ of a foot, and $\frac{9}{144}+\frac{6}{12}=\frac{9}{16}$ as expressed above; any question that is solved by duodecimals may be solved by vulgar, or decimal fractions.

4. It is required to multiply 8 ft. 3 in. by 4 ft. 3 in.

Ans. 35 ft. 0′ 9″ $=35\frac{1}{16}$ ft.

The same question by vulgar fractions.

8 ft. 3 in. $=8\frac{1}{4}$ and $8\frac{1}{4}$ is equal to $\frac{33}{4}$. 4 ft. 3 in. $=4\frac{1}{4}$, and $4\frac{1}{4}=$ to $\frac{17}{4}$, and $\frac{33}{4}\times\frac{17}{4}=\frac{561}{16}=35\frac{1}{16}$ ft. Ans.

The same question by decimal fractions.

8 ft. 3 in. $=8{\cdot}25$ ft. and 4 ft. 3 in. $=4{\cdot}25$ ft. and $8{\cdot}25\times4{\cdot}25=35{\cdot}0625$ ft. or $35\frac{1}{16}$ ft. Ans.

5. It is required to multiply 3 ft. 9 in. by 6 ft. 9 in.

Ans. 25 ft. 3′ 9″ or $25\frac{45}{144}$ ft.

The same question solved by vulgar fractions.

$3\frac{9}{12}=\frac{45}{12}$ and $6\frac{9}{12}=\frac{81}{12}\times\frac{45}{12}=\frac{3645}{144}=25\frac{45}{144}$ ft. Ans.

SUPERFICIAL MEASURE.

DEFINITION.—Superficial measure is that which respects length and breadth, without regard to thickness; the dimensions are various according to the nature of the thing measured; land is measured by superficial

measure, and its dimensions are generally taken in acres, rods and links: boards are also measured by superficial measure, and the dimensions are taken in feet and inches, &c.

Artificers' work is calculated by different dimensions.

Glazing by the square foot.

Masons' flat work, such as plastering, by the square foot or yard.

Painting, paving, &c. by the yard.

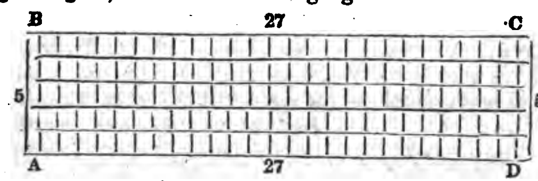
Partitioning, flooring, roofing, tiling, &c. are calculated by the square of 100 feet.

Brick work is generally calculated by the solid foot.

CASE I.

To measure a parallelogram.

Definition.—A parallelogram is a figure bounded by two parallel sides which are longer than two other sides which are parallel, which four sides make four right angles, as in the following figure.



Rule.—Multiply the length by the breadth, and such dimension as the length and breadth are taken in, such will be the dimension of the area; if feet, the area will be square feet, &c.

Note.—It is evident from the preceding figure, that if the length B C 27, be multiplied by the width A B, or D C 5, the product will be 135, and will be the number of squares contained in the figure.

EXAMPLES.

1. What is the area of a floor that is 22 feet 6 in. by 14 ft. 9 in.?

feet.		
22	6	
14	9	
308	84	
	198	54″
Area 331	10	6 Ans.

2. How many feet of boards will cover a floor of a hall, that is 41 ft. 9 in. by 30 ft. 6 in. allowing the floor to be 2 boards thick? Ans. 2546 ft. 9 in.

3. How many square feet are in a board that is 21 feet long, and 11 in. wide. Ans. 19 3′ = 19 $\frac{3}{12}$ ft.

4. How many square feet of boards will it take to lay a single floor, that is 28 ft. 6 in. long, and 14 ft. 6 in. wide? Ans. 413 ft. 3′.

CASE II.

To measure a board or any other plane, when it is wider at one end than the other, and of a true taper.

Rule.—Add together the width of the two ends, and half the sum is the mean width; or take the width in the middle (which is the same as the half of the sum of the width of the two ends,) then multiply the length by the mean width, the product is the answer, or area required.

EXAMPLES.

1. What is the superficial content of a board, that is 1 ft. 7 in. wide at one end, and 7 in. at the other; and 23 ft. 11 in. long?

ft. in. in. ft. in. ft. in.
1 7+7=2 2÷½=1 1 mean width.
1 ft. 1′ × 23 ft. 11′=25 ft. 10′ 11″ Ans.

2. What is the area of a piece of land that is 30 rds. long; 20 rods wide at one end, and 18 rds. at the other? Ans. 570 rds.

3. What is the area of a hall that is 32 ft. long; 22 ft. wide at one end, and 20 at the other? Ans. 672 ft.

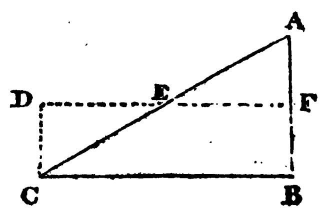
4. A man has a farm lying 300 rds. on the road, and the width of it at one end is 80 rds. and at the other 60: I demand the content of the farm.

Ans. 21000 rds. or 131 acres, 40 rds.

CASE III.

To measure the surface of a right angled triangle.

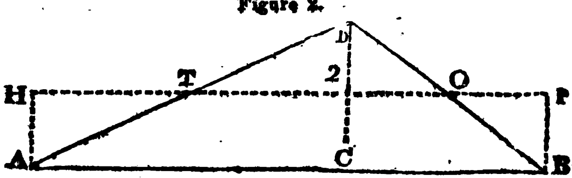
Definition.—A right angled triangle is formed by a right line falling perpendicularly on another line, as the line A B falling upon the line C B, makes a right angle at B.



Rule.—Multiply the base C B, by half the perpendicular A B, and the product will be the area; or multiply the base and perpendicular together, and half the product will be the area: also the perpendicular multiplied by half the base, the product is the area.

Note.—All triangles, not having one right angle, are in general terms called oblique angled triangles, &c. Figure second represents an oblique angled triangle; and the same rules that apply in measuring a right angled triangle will apply in measuring an oblique angled triangle.

Figure 2.



N 2

Explanation.—It is evident that the area of any triangle may be found by multiplying the base by half the perpendicular; or by multiplying the base and perpendicular together, and taking half the product; or by multiplying the perpendicular by half the base. By multiplying half of A B (fig. 1) by C B, the parallelogram D F C B is measured; E F A is in the triangle, and is not measured; C D E is not in the triangle and is measured in the parallelogram; C D E being equal to E F A there can be no loss sustained; in figure 2, multiplying half the perpendicular D C, by the base A B, reduces the triangle A D B to the parallelogram H P B A: T 2 D is equal to T H A, and D 2 O is equal to O P B. Therefore it is evident that the parallelogram H P B A is equal in area to the triangle A D B.

EXAMPLES.

1. What is the content of a piece of land 13½ rods on the base, and 8·8 rods on the perpendicular, in form of figure first?

Half perp. $=4{\cdot}4\times13{\cdot}5=59{\cdot}4$ rds. Ans.

2. What is the area of a piece of ground in form of figure 2d, base 27·4 rods; perpendicular 8·2 rods?

Ans. 112·34 rods.

3. What is the area of the gable end of a house, beam 40 feet, and height 12 feet 6 inches?

Ans. 250 sq. ft.

4. What is the superficial content of a piece of board, in form of figure first: the length of which is 16 ft. 9 in. and the wide end 1 ft. 10 in. and the narrow end coming to a point?

ft.	in.	in.	ft.	in.	ft.	in.	''	
1	10÷½=	11×	16	9=	15	4	3	Ans.

5. What is the content of the second figure, A B 20 ft. and C D 6 ft. 4 in. Ans. 63 ft. 4 in.

CASE IV.

Board Measure.

To make a board rule, and to measure boards with the same.

Rule.—Furnish a piece of hard wood of fine grain, three feet and a half long,* using six inches for a handle; plane it to as many as twelve sides; number each side or line at the lower end from 10 to 21, or from 12 to 23, as you may think proper; divide the staff into feet by driving in brass nails at every foot; divide each foot, on each line, into as many equal parts as are equal to the number on the line at the bottom; a foot on the line numbered 10 at the bottom, must be divided into ten equal parts to a foot, the line numbered 12, a foot must be divided into 12 equal parts: number these divisions on each line, beginning three or four divisions from the bottom, so that the figures on the divisions do not interfere with those on the lines at the bottom; after stamping the figures, fill them up with good black ink, and give the whole a coat of varnish, and the figures will appear very plain.

To measure boards with the above rule.

Rule.—Find the length of the board, then look on the end of the rule for the number corresponding to the length, apply that line of the *rule* to the middle of the board, and the width will extend on *that line* to a number expressing its area, or content.

EXAMPLE.

What is the area of a board that is 11 feet long and 12 inches wide? Ans. 11 feet.

Note.—The board being 11 feet long, I look for the line numbered 11 at the bottom, and apply that line of the rule to the middle of the board, and the width extends to the division on that line numbered 11, which is the content of the board.

---

*Any other length may be used, but I use this length as I think it most convenient.

CASE V.

To measure boards with Gunter's sliding rule.

RULE.—Bring the width of the board in inches, on the slider, against 12 on the line above; then look along on the line above for the number expressing the length of the board; and against that number, (on the slider) stands the number expressing the area of the board.

EXAMPLE.

What is the content of a board that is 18 feet long and 10 inches wide? Ans. 15 feet.

NOTE—I first brought the width of the board in inches, against 12 on the line above; I then looked on the line above for the length of the board, *viz.* 18; and against the length (on the slider) stood 15, the number answering to the area of the board.

CASE VI.

To measure boards with Gunter's scale and dividers.

RULE.—On the line of numbers extend from 1 to the width, and that extent will reach from the length to the superficial content or area; any right angled parallelogram may be measured by the same rule.

EXAMPLE.

What is the superficial content of a board that is 20 feet long and 1¼ feet wide? Ans. 25 feet.

NOTE.—On the line of numbers I extend from I, to 2½ tenths, or ¼ of the distance from 1 to 2; and that extent reaches from 20, (the length of the board) to the superficial content 25.

CASE VII.

To measure joist, plank, &c.

DEFINITION.—Joists are of different dimensions, sometimes 3 by 3, or 3 by 4, &c. plank are also of different thickness; and both plank and joists are reduced to board, or superficial measure, and are measured thus:

RULE.—Find the area of one side of the joist, or plank, by any of the preceding rules in superficies; multiply that area by the thickness in inches, the last product will be the superficial content of the joist, or plank.

EXAMPLES.

1. What is the superficial area, or board measure of a joist, that is 20 feet long 4 wide, and 3 thick ?

20 ft. 0′×0 ft. 4′=6 $\frac{8}{12}$ ft. ×3′ thick equal 20 ft. Ans.

2. What is the area or board measure of a plank that is 25 feet long, and 16 in. wide, and 3 in. thick?

Ans. 100 feet.

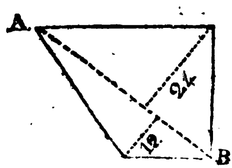
CASE VIII.

To measure any irregular plane surface.

RULE.—Divide the whole surface into triangles, and measure each triangle separately, as taught in case third, superficial measure.

EXAMPLE.

What is the superficial content of a plat of ground, in form of the following figure; diagonal A B 50 ft.; perpendicular, 24 and 12 ? Ans. 900.



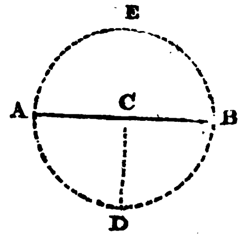
CASE IX.

To measure the surface of a circle.

DEFINITION.—Circles are round figures bounded every where by a circular line called the periphery, or arch, or sometimes the circumference; the line passing through the centre is called the diameter; half the diameter, or a line proceeding from the centre to the periphery is called the semi-diameter, or radius.

See the figure.

A E B D is the periphery or arch.
A B is the diameter of the same.
C D is the semidiameter or radius.



PROBLEM I.

Diameter given to find the circumference.

RULE 1.—As 7 is to 22 so is the diameter to the circumference.

RULE 2.—As 113 is to 355 so is the diam. to the circum.

EXAMPLE.

What is the circumferenee of a circle, which has a diameter of 14 rods.

By Rule 1. As 7 : 22 : : 14 to 44 rds. Ans.
By Rule 2. As 113 : 355 : : 14 to $43\frac{1}{113}$ Ans.*

PROBLEM II.

The circumference given to find the diameter.

RULE 1.—As 22 is to 7 so is the circumference to the diameter.

RULE 2.—As 355 is to 113 so is the circumference to the diameter.

RULE 3.—Annex two cyphers to the circumference and divide by 3,14 the quotient is the diameter nearly.

*The two methods do not exactly agree, the last method is nearest to the truth; an exact proportion between the diameter and circumference of a circle has not yet been discovered.

EXAMPLE.

What is the diameter of a circle whose circumference is 44 rods?

By Rule 1.—As 22 : 7 : : 44 : 14 Ans.
By Rule 2.—As 355 : 113 : : 44 : $14\frac{2}{355}$ Ans.
By Rule 3.—As $44\cdot00 \div 3\cdot14 = 14\frac{4}{314}$ Ans.

PROBLEM III.

The diameter and circumference given to find the area.

Rule.—Multiply half the diameter by half the circumference, the product is the answer; or multiply the diameter and circumference together and ¼ the product is the area.

EXAMPLE.

What is the superficial content of a circle whose diameter is 14 rds. and circumference 44 rds.?

rds. *rds.*
$14 \div \frac{1}{2} \times 44 \div \frac{1}{2} = 154$ square rods, Ans.

The same question done by rule second.
$14 \times 44 = 616 \div \frac{1}{4} = 154$ square rods, Ans.

PROBLEM IV.

The diameter given to find the area.

Rule.—Multiply the square of the diameter by ·7854 the product is the area.

EXAMPLE.

What is the area of a circle whose diameter is 14 rods?

rds.
$14 \times 14 \times \cdot 7854 = 153\cdot 9384$, Ans.

PROBLEM V.

The circumference given to find the area.

Rule.—Multiply the square of the circumference by ·07958, the product is the area.

EXAMPLE.

What is the area of a circle whose circumference is 44 rods?

$$44 \times 44 \times 07958 = 154{\cdot}06688, \text{ Ans.}$$

PROBLEM VI.

The area of a circle given to find the diameter.

Rule.—Divide the area by ·7854 and extract the square root of the quotient; the root is the diameter sought. (See application of square root, case 2.)

PROBLEM VII.

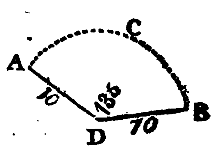
The area given to find the circumference.

Rule.—Divide the area by ·07958 and extract the square root of the quotient, and the root will be the circumference sought.

CASE X.

To measure a sector of a circle.

Definition.—The sector of a circle is a part of a circle bounded by an arc and two radii drawn to the extremities, see the figure A C B D. A C B the arc; A D, or D B the radii.



Rule.—Find the length of the arc A C B; to do which say as 180°, is to the number of degrees in the arc, so is the radius multiplied by 3·1416, to the length of the arc; having found the length of the arc, multiply the radius by half the arc, the product is the area required.

EXAMPLE.

What is the superficial content of the sector A C B D, the radius A D, or D B being 10 feet, and the arc A C B containing 135°?

As 180 : 135 : : $10\times3\cdot1416$: $\overset{ft.}{23\cdot562}$ length of the arc.

then $10\times23\cdot562\div\frac{1}{2}=\overset{ft.}{117\cdot81}$ Ans.

RULE.—Find the superficial content of a circle having the same radius; then say, as 360° (the degrees in a circle) are to the area of the whole circle; so are the number of degrees in the arc of the sector, to the superficial content of the same.

EXAMPLE.

What is the area of a sector of a circle whose arc contains 45 degrees, and the radius of the same is 20 feet? Ans. 151 sq. ft.

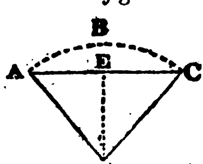
NOTE.—This method is exactly right, for it is evident that if a circle of 40 feet diameter contain 1256 sq. ft. that a sector of 45° with the same radius will be 1 eighth of the circle.

CASE XI.

To measure the segment of a circle.

A segment of a circle is a part of a circle bounded by part of the circle's periphery, and a chord connecting the two extremities of the periphery, A B C is a segment.

See the figure.



NOTE.—The quantity of the angle A D C is 82°.

RULE.—Measure the sector ABCD by case 10, and also measure the triangle ADC, and subtract the area of the triangle from the area of the sector; and the remainder will be the area of the segment ABC.

EXAMPLE.

What is the area of the segment A B C, whose arch contains 82° : and its chord A C 17·5 feet: and the perpendicular of its triangle D E 10·4 feet: and semidiameter A D, or D C 13·7 feet ?

First find the area of a circle whose diameter is 27·4 feet.

ft.
As 113 : 355 : : 27·4 : 86† circumference.
27·4×86=2356·4÷¼=589·1 area of circle.

To find the area of the sector, say

area.
As 360° : 589·1 : : 82° : 134·1 the area of the sector A B C D.

To find the area of the triangle.

The chord A C=17·5, perpendicular D E 10·4×17·5 =182÷½=91 feet area of the triangle A D C.

Area of the sector A B C D=134·1
Area of the triangle A D C= 91·0

Area of the segment A B C= 43·1 ft. Ans.

CASE XII.

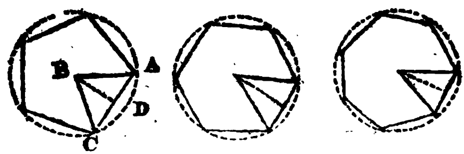
To find the area of a polygon.

DEFINITION.—A polygon is a figure having equal sides and equal angles, see figures 1. 2. 3.

RULE.—Multiply half the length of all the sides by the nearest distance from the centre to any of the sides; or multiply the area of one of the triangles by the number of triangles contained in the figure, the product is the answer.

Figures.

1 2 3



In measuring figure first, it is evident that multiplying the distance from the centre to any side, by half the length of all the sides is measuring 5 equal triangles; the sides represent the bases, and distance from the centre, to a side of the perpendicular.

EXAMPLES.

1. What is the area of figure first A C equal to 8 ft. B D equal to 5·8 ft.?

$8 \times 5{\cdot}8 = 46{\cdot}4 \div \frac{1}{2}$ 23·2 area of B A C.

There being 5 triangles contained in this figure, the area of one viz. 23·2 multiplied by 5 will give the area of the polygon. $23{\cdot}2 \times 5 = 116{\cdot}0$ Ans.

2. What is the area of figure second, the distance from the centre to a side is 6 feet; the sides are 6, and their length 7 feet? Ans. 126 feet.

3. What is the area of figure third, the distance from the centre to a side 6·2 feet; number of sides 7; their length 5·9 feet? Ans. 128·03 feet.

CASE XIII.

To describe and find the area of an ellipsis, or oval.
First, to describe an oval or ellipsis.

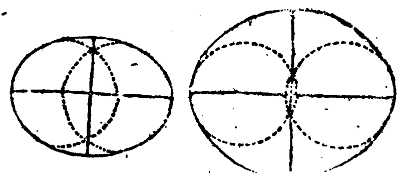
Rule.—Draw a line and set one foot of the dividers on said line as a centre, and describe a circle, and move the dividers to some other point on the given line (less than the semidiameter) and describe another circle of the same radius, and in the two points where the circle's

peripheries intersect, set the dividers and complete the sides of the oval, and through these two points, draw the conjugate diameter, crossing the transverse diameter n the centre of the oval.

NOTE.—The longest diameter of an oval is called the transverse, and the shortest, the conjugate diameter.

Figures.

1st. 2nd.



To find the area of an ellipsis.

RULE.—Multiply the transverse by the conjugate diameter, and this again by ·7854, and the last product is the area; or multiply the two diameters together and $\frac{11}{14}$ of the product is the answer.

EXAMPLES.

1. What is the area of figure first, the longest diameter is 17·5 and shortest 13?

$17·5 \times 13 \times ·7854 = 178·67850$ area Ans.

2. What is the area of figure second, the longest diameter being 21, and the shortest 17?

By rule first, $21 \times 17 \times ·7854 = 280·3878$ area.

By rule second, $21 \times 17 = 357 \div \frac{11}{14} = 280\frac{7}{14}$ Ans.

CASE XIV.

To find the area of a globe or sphere.

DEFINITION.—A globe or sphere is bounded by a circumference every way equally distant from a point within called the centre, thus a cannon ball may be called a globe or sphere.

RULE.—Multiply the diameter and circumference together, the product is the area.

EXAMPLES.

1. What is the superficial area of a globe whose circumference is 44, diameter 14?

$44 \times 14 = 616$ area Ans.

2. What is the area of the globe we inhabit, allowing it to contain 360 degrees and $69\frac{1}{2}$ miles to a degree on the equator?

$360^{\circ} \times 69\frac{1}{2} = 25020$ circum. and 7964 diam. nearly.

$25020 \times 7964 = 199259280$ area in square miles.

SOLID MEASURE.

DEFINITION.—The mensuration of solids includes the measuring of all bodies which have length, breadth and thickness; such as timber, stone and wood, &c.

In solid measure 1728 inches make a foot, that is 12 inches in length, 12 in breadth, and 12 in thickness; thus a solid foot would make 1728 little blocks, one inch square.

GENERAL RULE.

Multiply the length, breadth and thickness together, the last product is the solidity required.

CASE I.

To find the solidity of a prism.

DEFINITION.—A prism represents a three cornered file, that is all its length of the same bigness; therefore the ends are triangles.

RULE.—Find the area of one end, multiply this area by the length of the prism, the last product will be the solidity.

NOTE.—If the area of the end is found in inches, and multiplied into the length in inches, the solidity is in solid inches, and must be divided by 1728 to bring it to solid feet; if the area of one end in inches is multiplied into the length in feet, dividing by 144 will give the solidity in solid feet.

EXAMPLES.

1. What is the solidity of a prism, the sides of the triangles of which measure 13 inches and the perpendiculars of its triangle 12 inches; and its length 12 feet?

in. in.

$13 \times 12 \div \frac{1}{2} = 78 \times 12$ feet $= 936 \div 144 = 6\frac{72}{144}$ Ans.

2. What is the solidity of a prism the base of which is 2 feet 3 inches; and the perpendicular of which is 1 foot 10 inches; and length 20 feet 6 inches?

Ans. 42 feet 3′ 4″ 6‴.

CASE II.

To find the solidity of any figure that is of equal width and equal thickness.

RULE.—Multiply the length, breadth and thickness together, the last product is the solidity.

EXAMPLES.

1. How many solid feet are in a hall, that is 36 feet 6′ long, 14 feet 6′ wide, and 8 feet 6′ high?

36 feet 6′ $\times$ 14 feet 6′ $\times$ 8 feet 6′ $=$ 4498 feet 7′ 6″, or 4498 $\frac{5}{8}$ feet Ans.

2. How many solid feet will be occupied by 21 chests of tea, which are 3 feet 3 inches every way?

Ans. 720$\frac{57}{64}$ feet.

CASE III.

To find the solidity of any figure that has equal thickness, but unequal width.

RULE.—Find the mean width by adding together the width of both ends, and taking half the sum for the mean width: the width taken in the middle is also the mean width; multiply the mean width, depth and length together, and the product is the solidity.

EXAMPLES.

1. How many solid feet are in a stone that is 21 feet

long, 2 feet wide at one end, and 3 feet at the other, and 1 foot 6 inches thick.

$2+3=5\div\frac{1}{2}=2{\cdot}5\times21\times1{\cdot}5=78{\cdot}75$ Ans.

2. How many solid feet in a stone wall that is 51 feet long, and 7 feet high, and mean thickness 2 ft. 6′ ?

Ans. $892\frac{1}{2}$ feet.

CASE IV.

To find the solidity of a cylinder.

Definition.—A cylinder is a long round body, all its length of equal bigness.

Rule.—Find the area of one end, and multiply it by the length, the last product is the solidity. To find the area of one end, apply the rule for measuring a circle. (*See Circles.*)

EXAMPLES.

1. What is the solidity of a cylinder that has a diameter 22 inches, and is 20 feet long?

diam. circum.
$22\times69{\cdot}14=1521{\cdot}08\div\frac{1}{4}=380{\cdot}27$ area. $380{\cdot}27\times20$ ft.$=$ $7605{\cdot}4\div144=52{\cdot}81$ ft. Ans.

2. What is the solidity of a cylinder that has a diameter $9\frac{1}{2}$ feet, and is 21 feet long?

Ans. 1488·69.

3. What is the solidity of a cylinder, whose diameter is 7 inches, and circumference 22, and is 20 feet long?

Ans. $5\frac{50}{144}$ ft.

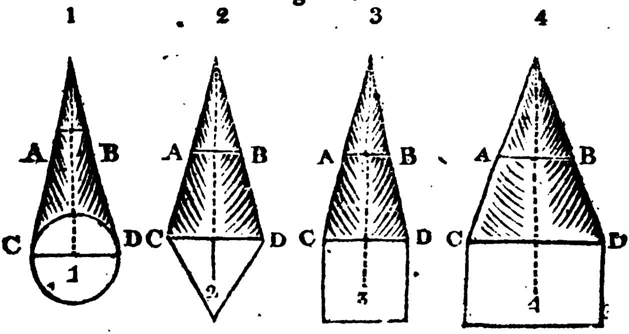
CASE V.

To find the solidity of a cone or pyramid.

Definition.—A cone is a figure standing upon a base, and of a true slant or taper from the largest end, to a point or vortex. The base is either circular, square, triangular, or in form of a parallelogram; the base of the first figure is a circle; the second is a triangle; the third is a square; the fourth is a parallelogram.

A frustum of a cone is a piece cut off parallel to the base: that part between A B and C D in the following figures is called a frustum; the length of the frustum is represented by the perpendicular line, proceeding from the centre of the base, to the line A B.

Figures.



RULE.—Find the superficial area of the base, and multiply it into one third of the perpendicular height of the cone, and the product will be the solidity.

EXAMPLES.

1. What is the solidity of figure first; perpendicular 21 feet, and the diameter of the circle at the base $9\frac{1}{2}$ ft.?

9·5 diameter, 29·85 circumference.

Half diam. & half circu. $4.75 \times 14·925 = 70·89$† area of base.

Area $70·89 \times 21 = 1488·69 \div \frac{1}{3} = 496·23$† feet, solidity.

2. What is the solidity of figure 2d; perpendicular 21 feet, sides of its triangle 10, and perpendicular of its triangle $8\frac{1}{2}$?

$10 \times 8\frac{1}{2} = 85 \div \frac{1}{2} = 42·5 \times 21 \div \frac{1}{3} \times 297·5$ solidity, Ans.

3. What is the solidity of figure third; perpendicular height 21, and the sides of its base 9 feet?

$9 \times 9 = 81 \times 21 \div \frac{1}{3} = 567$ ft. Ans.

4. What is the solidity of figure fourth; perpendicular height equal 21, and sides 15 by $9\frac{1}{2}$?

Ans. 997·5 ft.

CASE VI.

To find the solidity of the frustum of a cone, &c.

RULE I.—Find the superficial area of both ends, add the two areas together, and reserve the sum; multiply the two areas together, extract the square root of the product, and add the root to the reserved sum, and multiply the sum by one third the perpendicular height, the product is the solidity required.

RULE II.—If the cone is exactly square at both ends, multiply a side of the greatest, by a side of the least square; also find the difference between the two sides; square the difference; add one third of the square to the product of the two sides; multiply the last sum by the length, the product is the solidity.

EXAMPLES.

1. What is the solidity of the frustum A B C D; figure first, case 5th; largest diameter $9\frac{1}{2}$; smallest 3; and length 14?

Largest diam. $9{\cdot}5\times9{\cdot}5\times{\cdot}7854=70{\cdot}88$† area largest end,
Smallest diam. $3{\cdot}0\times3{\cdot}0\times{\cdot}7854=7{\cdot}06$† area least end.

Areas $70{\cdot}88\times7{\cdot}06=\sqrt[2]{500{\cdot}4128}=32{\cdot}36$ root added.

——— len.

Ans. $100{\cdot}30\times14\div\frac{1}{3}=468\ 06$†.

2. What is the solidity of the frustum A B C D, figure second, case fifth; the sides of its largest triangle 10, and its perpendic. $8\frac{1}{2}$; sides of the smallest triangle 3·5 and the perpendicular of its triangle 3; & length 14?

$10\times4\frac{1}{4}=42{\cdot}5$ area largest end.
$3{\cdot}5\times1{\cdot}5=5{\cdot}25$ area smallest end.

Areas $42{\cdot}5\times5{\cdot}25=\sqrt[2]{223{\cdot}1250}=14{\cdot}93$ root added.

sum 62 68

sum $62{\cdot}68\times4\frac{2}{3}=292{\cdot}5$ solidity, Ans.

3. What is the solidity of the frustum A B C D, figure third, case 5th; sides of its largest square 9, and the smallest 3, and length 14?

Same question by rule second.

Sides of the two squares 9×3=27 product.
9—3=6 dif. × 6=36÷ ⅓ = 12 add.

—— Solidity.
30×14=546 Ans.

4. What is the solidity of the frustum A B C D, figure fourth, case fifth; sides of the largest end 15 by 9½; sides of the smallest end 5 by 3·2; and 14 long?

Sides of the largest end 15×9·5=142·5 area.
Sides of the smallest end 5×3·2= 16·0 area.

Areas 142·5×16=$\sqrt[2]{2280{\cdot}0}$=47·7† root 47·7 add.

sum 206·2

206·2×14=2886·6÷⅓=962·2† Ans.

5. What is the solidity of the frustum of a cone that is 10 fe et square at one end, and 4 at the other, and is 32 feet long? Ans. 1664 ft.

6. What is the solidity of the frustum of a cone that is 16 in. square at one end, and 12 at the other, and is 16 feet long? Ans. 21$\frac{1}{3}$.

7. What is the solidity of the frustum of a cone that is 24 in. square at one end and 21 at the other, and is 10 feet long? Ans. 35$\frac{5}{24}$.

CASE VII.

To find the solidity of the segment of a cone, as the parts above A B in the figures, case 5th.

RULE.—This part forms a cone of itself, and must be measured by case fifth.

CASE VIII.

To find the solidity of a wedge, when the edge and large end are of equal width.

RULE.—Multiply the length and width together, and that product by half the thickness, the last product is the solidity.

EXAMPLES.

1. What is the solidity of a wedge that is 12 ft. long, 12 wide, and 6 thick, at the large end?

$12 \times 12 = 144 \times 6 \div \frac{1}{2} = 432$ solidity, Ans.

2. What is the solidity of a wedge that is 10 ft. long, 6 inches wide, and 6 thick? Ans. $1\frac{1}{4}$ ft.

CASE IX.

To find the solidity of a wedge when the edge is narrower than the large end.

RULE.—To the width of the edge add twice the width of the large end, and reserve the sum: multiply the length of the wedge by the thickness of the large end; multiply this last product and the reserved sum together, and divide by 6; the quotient is the solidity.

EXAMPLES.

1. What is the solidity of a wedge that is 12 ft. long, and 18 in. wide at the largest end, and 12 in. wide at the edge; and 6 in. thick at the large end?

Width of the edge - 12
Width of the large end $18 \times 2 = 36$

48 reserved sum.

Length of wedge	144	inches.
Thickness of large end	6	inches.
	864	product.

Pro. $864 \times 48 = 41472 \div 6 = 6912$ in. or 4 ft. Ans.

2. What is the solidity of a wedge that is 20 ft. long, 15 wide at the large end, and 10 at the edge; and 12 thick? Ans. 1000.

NOTE.—This rule will give the solidity of a cone when it is square, or in form of a parrallelogram.

EXAMPLE.

What is the solidity of the cone, figure third, case

fifth; width of the large end 9, thickness 9, and length 21?
Width of the edge - 0
Width of the large end $9\times2=18$

18 reserved sum.

$21\times9=189\times18=3402\div6=567$ Ans.

(*See Ans. to Quest. 3 Case fifth.*)

CASE X.

To find the solidity of a globe, or sphere.

Definition.—A globe or sphere is a round body bounded by a surface every point of which is equally distant from a point within called the centre; a line passing from one side to the other through the centre is called the diameter, or axis.

Rule.—Cube the diameter, or axis, and multiply its cube by ·5236 the last product is the solidity.

EXAMPLES.

1. What is the solidity of a globe, or sphere whose diameter is 113?
$113\times113\times113\times{\cdot}5236=7355500{\cdot}8692$ solidity.

2. What is the solidity of the globe which we inhabit, in solid miles; allowing its circumference to be 25000 miles?

As 22 is to 7 so is 25000 to 7954 diam. nearly. (Fractions omitted.) 263485304337 sol. miles Ans.

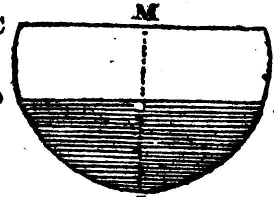
3. What is the solidity of a cannon ball that is 9 inches on its diameter? Ans. 381·7044 sol. in.

4. What is the solidity of a sphere whose diameter is 2 ft. 8 in.? Ans. 9·927 ft. solidity.

CASE XI.

To find the solidity of a segment, or part off a globe, or sphere; or part of a globe cut of parallel to the diameter, as part D C F.

See the figure.



Rule.—Square the radius of its base, (as D o, or F o) multiply its square by 3, and reserve the product; square the depth o C, add the square and reserved product together; and multiply the sum by the depth o C; and the last product by ·5236; the product is the solidity.

EXAMPLES.

1. What is the solidity of the segment D C F, radius D o, or F o, 7; and depth o C, 5?

Radius $7 \times 7 \times 3 = 147$ reserved product.
Depth $5 \times 5 = 25$ add.

$172 \times$ depth $5 = 860 \times \cdot 5236 = 450 \cdot 296$.

2. Required the solidity of a segment of a globe, whose semidiameter is 9 in. depth 9 in.

Ans. 1526·8176 in.

CASE XII.

To find the solidity of the middle zone of a sphere, or globe; or the part of a sphere after two segments have been cut off, parallel to the diameter or axis, as C D E F in figure, case eleventh.

RULE.—Square the semidiameter of both ends and add the squares together, and reserve the sum: square the height, or distance of the two ends, as o M, and add ⅓ of its square to the reserved sum; multiply the sum by the height, or distance o M, and this product again by 1·5708; the last product is the solidity.

EXAMPLES.

1. What is the solidity of the middle zone C D E F, (case eleventh); diameter C E, or D F, 14, and height o M, 3?

NOTE.—In this example the diameters are alike, which is not always the case.

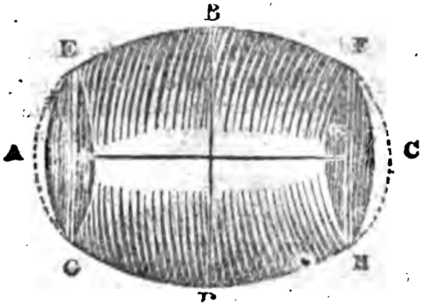
Diam. 14 semi. $=7\times7=49$
Diam. 14 semi. $=7\times7=49$
Height o M $3\times3=9\div\frac{1}{3}=\ \ 3$ add.
——— ht.
Ans. $101\times3=303\times1{\cdot}5708=475{\cdot}9524$.

2. What is the solidity of the middle zone of a sphere whose greatest diameter is 12, and least 8, and height or length 10? Ans. 1340·411.

CASE XIII.

To find the solidity of a spheroid, or ellipsoid; and also to find the solidity of the middle frustum of a spheroid.

DEFINITION.—A spheroid is a solid generated by the revolution of an ellipse, or oval, about the transverse of conjugate diameter. [See the figure A B C D.]



To find the solidity of the spheroid A B C D.

RULE.—Multiply the revolving diameter B D, into itself, and the product by the fixed diameter A C, and the product again by ·5236, the last product is the solidity.

EXAMPLES.

1. What is the solidity of a spheroid whose revolving diameter B D is 20, and fixed diameter A C is 30?
Revolv. diameter 20×20=400×30×·5236=6283·2 Ans

2. What is the solidity of a spheroid whose revolving diameter is 30, and fixed diameter 50? Ans. 23562.

To find the solidity of the middle frustum of a spheroid.

RULE.—To the square of the end diameter, add twice the square of the middle diameter, multiply this sum by the length, and the product again by ·2618, the last product is the solidity.

EXAMPLES.

1. What is the solidity of the frustum E F G H, length 40, end diameters E G, or F H 24, and middle diameter B D 32?

End dia.24×24 = 576
Mid. dia.32×32×2=2048 add.

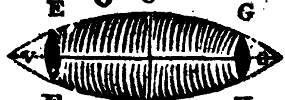
2624×40×·2618=27478·5280Ans.

2. What is the solidity of the middle frustum of a spheroid, whose length is 30; middle diameter 25; and end diameter 20 inches? Ans. 12959·1.

CASE XIV.

To find the solidity of an elliptic spindle.

Definition.—An elliptic spindle is formed by any of the three conic sections revolving about a double ordinate; the following figure represents an elliptic spindle.



Rule.—Find a diameter half way between the middle and end, as at O P, multiply it by 2, square the product and add the square to the square of a diameter taken in the middle, multiply the sum by the length, and the product again by ·1309, the last product is the solidity, very nearly.

EXAMPLES.

1. What is the solidity of the elliptic spindle V B C D; length 15; diameter C D 5; and diameter taken half way between the middle and end equal to 4?

Diam. O P. 4×2=8×8=64 sq. of twice O P.
Diam. C D 5×5=25 sq. of C D add.

89 sum.

Sum 89×15×·1309=174·7515 Ans.

2. What is the solidity of an elliptic spindle that is 20 long; greatest diameter 15; and the diameter half way between the middle and end, equal to 10?

Ans. 1636·25.

CASE XV.

To find the solidity of the middle frustum of an elliptic spindle.

Rule.—To the square of twice a diameter taken half way between the middle and end, add the squares

of the middle end diameters; multiply the sum by the length, and again by ·1309, the last product is the solidity required.

NOTE.—E F G H in the preceding figure represents the middle frustum of an elliptic spindle.

EXAMPLES.

1. What is the solidity of the middle frustum E G F H, length 10; diameter at the end 4; diameter C D 6, and diameter taken at O P equal to 5?

Diam. O P $5\times2=10\times10=100$ sq. of twice O P.
Diam. C D $6\times6=36$ sq. of C D.
Diam. E F or G H $4\times4=16$ sq. of E F or G H.

152 sum.

Sum $152\times10\times{\cdot}1309=19{\cdot}8968$ Ans.

CASE XVI.

*The common, but erroneous method of finding the solidity of square timber contained in a round stick.**

RULE.—In order to ascertain the quantity of hewn timber contained in a round stick, it has been the common practice to girt the stick in the middle with a line, (after taking off the bark) and then to double the line into four equal parts, and one of these parts is considered equal to a side of square timber, that can be hewn from the stick; which side is multiplied into itself in inches, and the product by the length in feet; the last product divided by 144 is considered the solidity in solid feet.

EXAMPLES.

1. What solidity of square timber, can be hewn from a round stick that is 21 ft. long, and its circumference, or girt line 48 inches?

Girt $48\div\frac{1}{4}=12\times12=144\times21=3024\div144=21$ ft. Ans.

*This method gives too much for the solidity, if it is meant to measure the solidity of square timber only; and not enough if it is meant to include the four slabs, or segments.

2. What is the solidity of square timber in a round stick that is 30 ft. long, and its circumference or girt measures 24 inches? Ans. $7\frac{1}{2}$ ft.

3. What is the solidity of a stick of timber that girts 56 inches, and its length being 11 ft. 9 inches?

Ans. 15 ft. 11′ 11″, or $15\frac{143}{144}$ ft.

4. What is the solidity of square timber in a stick of round timber, that girts 50 in. and is 31 ft. 7 in. long?

Ans. 34 ft. 3′ 2″ 10‴ 9⁗ or 34[illegible].

CASE XVII.

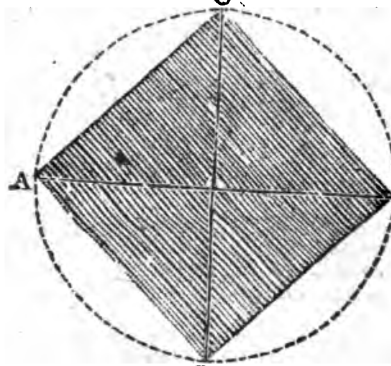
A new and more accurate method of finding the solidity of square timber that is contained in a stick of round timber; or to find how much the stick will measure after it is hewn square.

Rule.—Girt the stick (after taking off the bark,) and annex a cypher to the girt in inches and divide the whole by 4·4 the quotient is a side of the greatest square in inches that can be hewn from such a stick; multiply this side into itself, and this product again by the length in feet, and the last product divided by 144 will be the solidity of the stick in feet after it is hewn.

Illustration of the preceding rule.

Make a circle whose diameter is 20, and of course its circumference would be 62·8† (which may represent the girt line of a stick of timber;) annex a cypher to the circumference and divide by 4·4, the quotient will be 14·3 nearly, now make the largest square in this circle that can be made in it, and you will find that the sides of the square will be 14·3 very nearly; but if the same circumference were divided by $\frac{1}{4}$, (which would represent the length of the girt line in case sixteenth, after it was doubled into four equal parts) you would find that the quotient would be 15·7 for a side of the square timber.

The following figure will further illustrate the preceding rule.



Diameter A B or C D 20, and the sides of the square A D, or D B, or B C, or C A 14·3, and are sides of the greatest square that can be made in the circle.

EXAMPLES.

1. What solidity of square timber can be hewn from a stick that is 20 feet long, and girts 62·8 in.?

Girt 62·80÷4·4= 14·3 nearly × 14·3=204·49× by length 20=4089·80÷144=28·4† solidity, Ans.

The same question solved by case sixteenth.

Girt 62·8÷ ¼ =15·7×15·7=246·49 × length 20= 4929·80 ÷144=34·2† solidity, Ans.

NOTE.—By comparing the two preceding answers, it is evident that the last method of operation gives two much for the solidity of square timber in such a stick.

	ft.
Solidity found by using ¼ the circum.	34·2†
True solidity found by case 17th	28·4†
difference	5·8

2. What is the solidity of square timber in a stick of round timber, that is 21 feet long, and 48 inches in circumference?

Girt $48\cdot0 \div 4\cdot4 = 10\cdot9$† a side of square timber in the stick.
$10\cdot9 \times 10\cdot9 \times 21 = 2495\cdot01 \div 144 = 17\ 32$† solidity, Ans.

The same question solved by using ¼ of the circumference.

Girt $48 \div \frac{1}{4} = 12 \times 12 \times 21 = 3024 \div 144 = 21$ ft. Ans.
Difference 3·68 ft. too much.

3. What is the solidity of square timber in a stick of round timber, that is 11 ft. 9′ long, and girts 56 inches?

Girt $56\cdot0 \div 4\cdot4 = 1$ *ft.* $0'\ 8''$† *a side* $\times$ 1 ft. $0'\ 8'' = 1$ ft. $1'4''\ 5'''4''''$ mul. by the length 11ft. $9' = 13$ ft. $1'1''2'''8''''$ Ans.

4. What solidity of square timber is in a round stick, that is 31 ft. 7 inches long, and girts 50 inches?

$50\cdot0 \div 4\cdot4 = 11$† $11'$, a side. Ans. 26 ft. $6'\ 5''\ 7'''$.

NOTE.—Having shown by the two first questions in this case, that using ¼ of the circumference for a side of square timber, gives too much for the solidity, or more than the stick will measure after it is hewn square; it now remains to show that ¼ of the circumference multiplied by itself, and then by the length, does not produce the solidity of the stick, if the four segments, or slabs are to be included.

EXAMPLES.

1. What is the solidity of a stick of timber whose length is 20 ft. circumference 62·8 in. and diameter, 20 in. measured by using ¼ of the circumference?

Ans. 34·2† ft.

The same stick measured as a cylinder.

Ans. 43·5† ft.

Exact solidity of the stick	43·15 ft.
Erroneous solidity	34·2† ft.
diff.	9·3 ft.

NOTE.—It is obvious from the preceding examples that the square of ¼ the circumference, multiplied by the length, gives too much for the solidity of square timber in the stick, (or more than it would measure if it were hewn square): and not enough if the four slabs, or segments are to be included; It ought to be a matter of consideration by those concerned in buying and selling timber, how it should be

measured; and if it is agreed by the parties to measure only the square timber, (or what the stick would measure if it were hewn) then apply the rule in case 17th; but if it is agreed to measure the whole solidity of the stick (including the segments, or four slabs,) then apply the rule in the following case.

CASE XVIII.

To find the solidity of a round stick of timber, including the four slabs, or segments.

Rule.—Girt the stick in the middle (after taking off the bark), annex two cyphers to the girt, or circumference, and divide by 3·14 the quotient is the diameter nearly: multiply the girt, or circumference and diameter together; and one fourth part of the product multiplied into the length will be the solidity required.

EXAMPLES.

1. What is the solidity of a stick of timber, that girts 94·2 in. and length 20 feet?

$94{\cdot}20 \div 3{\cdot}14 = 30$ diam. $94{\cdot}2 \times 30 \div \frac{1}{4} = 706{\cdot}5 \times 20 \div 144 = 98\frac{18}{144}$ ft. Ans.

2. What is the solidity of a stick of timber, that is 22 ft. long; and the girt line measuring 31·4 in?

Ans. $11\frac{143}{144}$.

Note.—In all the preceding examples in timber measure, the timber has been considered of equal bigness from end to end; it now remains to treat of tapering timber, both round and hewn.

CASE XIX.

To find the solidity of hewn timber in a round stick, when the stick is tapering from end to end.

Rule.—Girt the stick at both ends, annex a cypher to the girts, or circumferences, and divide each girt by 4·4 the quotients will be the sides of square timber, multiply the two sides together; find the difference between the two sides; square the difference, and add one third of its square to the product of the two sides, and multiply this sum by the length, the last product is the solidity required.

EXAMPLES.

1. How much hewn timber is in a stick of round timber, that is 24 ft. long, and its circumference at one end is 44 in. and at the other 22 in.?

Cir. 44·0÷4·4=10 a side of the largest square.
Cir. 22·0÷4·4=5 a side of the least square.
Sides of the two squares 10×5=50 product.
Sides 10—5×5=25÷$\frac{1}{3}$ = $8\frac{1}{3}$ added.

$58\frac{1}{3}$ sum.

Sum $58\frac{1}{3}$ ×24 ft. = 1400÷144=$9\frac{104}{144}$ ft. Ans.

2. How much hewn timber is in a stick that is 21 ft. long, and its circumference at one end is 88 in. and at the other 44 in.? Ans. $34\frac{4}{144}$ ft.

Note.—If it is required to find how much hewn timber is contained in a round stick, allowing the square timber to be all its length of equal bigness, the round stick must be girted only at the smallest end.

CASE XX.

To find the solidity of a round stick of timber which is of a true taper from end to end, including the four segments, or slabs.

Rule.—Apply the rule for finding the solidity of the frustum of a round cone.

(*See Frustum of Cones, Case Sixth, Solids.*)

EXAMPLE.

What is the solidity of a stick of timber whose largest circumference is 63, and smallest 43 in.; and is 21 feet long?

Cir. 63·00÷3·14=20·0† diam.
Cir. 43·00÷3·14=13·7† diam. nearly.
Cir. and diam. 63×20=1260÷$\frac{1}{4}$=315 area, large end.
Cir. and diam. 43×13·7=589·1÷$\frac{1}{4}$=147† area small end.
Areas 315×147=$\sqrt[2]{46305}$ = 215† root add.

677 sum.

Sum 677×21÷$\frac{1}{3}$=4739÷144=$32\frac{131}{144}$ ft. Ans.

NOTE.—This method of operation would be too lengthy for common use; and if the following rule be adopted, the solidity may be found very near the truth (although a little too small) with much more convenience.

RULE 2.—Girt the stick near the middle (but rather nearest the butt end,) the girt is the circumference; annex two cyphers to the circumference; and divide by 3·14 the quotient is the diameter nearly; multiply the circumference and diameter together, and $\frac{1}{4}$ of the product multiplied into the length will give the solidity very near.

EXAMPLES.

1. What is the solidity of a round stick of timber (including the four segments) which is 12 ft. long; and its middle girt, or circumference is 62·8 inches?

Opr. 62·80 ÷ 3·14 = 20 diam.; and 20 × 62·8 = 1256·0 ÷ $\frac{1}{4}$ = 314 × 12 = 3768 ÷ 144 = 26$\frac{1}{6}$ ft. Ans.

2. What is the solidity of a round stick of timber that is 10 ft. long; and its mean girt 31·4 inches, including the four segments or slabs. Ans. 5 $\frac{65}{144}$ ft.

3. What is the solidity of a round stick of timber, whose mean girt is 94·2 in.; and 30 feet long?

Ans. 147 $\frac{27}{144}$ ft.

CASE XXI.

To find the solidity of a hewn stick of timber that has all its sides parallel.

RULE.—Multiply one side by the other, and the product multiplied by the length, will be the solidity.

EXAMPLES.

1. What is the solidity of a stick of hewn timber that is 30 ft. 6 in. long; and one side is 1 ft. 3 in.; the other side 6 in.?

30 ft. 6′ × 1 ft. 3′ × 0 ft. 6′ = 19 ft. 0′ 9″ or 19 $\frac{1}{16}$ ft. Ans.

NOTE.—Stone is measured in the same manner as square or hewn timber.

2. What is the solidity of a stone that is 12 ft. 6 in. long, 4 ft. 10 in. wide, and 0 ft. 9 in. thick?

Ans. 45 ft. 3′ 9″.

NOTE.—When two sides of the stick are parallel, multiply the mean width and the other side together, and the product by the length.

3. What is the solidity of a stick of timber that is 12 in. wide at one end, and 8 at the other; and is 8 in. thick, and 3 ft. 4 in. long?

Ans. 1 ft. 10′ 2″ 8‴.

CASE XXII.

To find the solidity of a tapering hewn stick of timber, which has no two sides parallel.

RULE.—Apply the rule for finding the solidity of the frustum of a cone or pyramid, (see case sixth;) if the stick is square at each end, measure it as in case 6th, rule 2.

EXAMPLES.

1. What is the solidity of a stick of hewn timber that is 10 in. square at one end, and 4 in. at the other, and is 32 feet long?

Sides of Sq. $10\times4=40$ pro.
Sides $10-4=6\times6=36\div\frac{1}{3}=12$ add.

Sum 52

Sum $52\times32=1664\div144=11\frac{5}{9}$ ft. Ans.

2. What is the solidity of a stick of timber that is 15 in. by 12 at one end; and 9 by 6 in. at the other end, and 21 ft. long?

Sides $15\times12=180$ area of largest end.
Sides $9\times\ \ 6=\ \ 54$ area of smallest end.

234 sum of the two areas.

A. $180\times54=\sqrt[2]{9720}=98\dagger$ root add.

Sum $332\times7=2324\div144=16\frac{5}{36}$ ft. Ans

NOTE.—The preceding method of measuring hewn tapering timber gives the exact solidity; but the method of taking the dimensions in the middle of the stick does not give the exact solidity, except in such sticks as have two or more sides parallel.

1. Required the solidity of a stick of timber that is 10 by 10 in. at one end, and 4 by 4 in. at the other end; and is 32 feet long; measured by taking the mean between the two ends?

Sides $10+4=14\div\frac{1}{2}=7$ mean side.

Mean side $7\times7\times32=1568\div144=10\frac{8}{9}$ Ans.

Solidity too small by $\frac{8}{9}$ of a foot, (see quest. 1, case 22.)

2. What is the solidity of a stick of timber, which on one side is 15 in. at one end, and 12 the other; and on the other side it is 9 in. at one end, and 6 the other; and is 21 feet in length?

Ends $15+12=27\div\frac{1}{2}=13\frac{1}{2}$ mean side.

Ends $9+6=15\div\frac{1}{2}=7\frac{1}{2}$ mean side.

Sides $\frac{27}{2}\times\frac{15}{2}\times\frac{21}{1}\div\frac{144}{1}=14\frac{441}{576}$ ft. Ans.

and is $1\frac{215}{576}$ ft. smaller than the true answer. (See question 2, case 22.)

NOTE.—This last method of measuring hewn tapering timber, being more convenient than the method of measuring it as a frustum of a cone, it is generally put in practice.

CASE XXIII.

To find the solidity of timber by Gunter's sliding rule allowing $\frac{1}{4}$ of the circumference to be a side of square timber in the round stick.

RULE 1.—Look first for the length of the stick in feet upon the brass slider, slip the slider to bring the figures expressing the length, to 12 on the girt line below, then look on the girt line for the quarter girt of the stick, and against the quarter girt (on the slider) stands the figures expressing the solidity of the stick.

To find the solidity of a stick of timber, allowing 4·4 of the circumference to be a side of square timber.

Rule 2.—Girt the stick where it would tip easy if it were lying upon another log, annex a cypher to the girt in inches, and divide by 4·4, the quotient is a side of square timber: then proceed as above.

To find the solidity of hewn timber by Gunter's rule.

Rule 3.—Add the four sides together, take ¼ of the sum for the mean side, proceed as above, and the answer will be very near the true solidity.

CASE XXIV.

WOOD AND BARK MEASURE.*

Rule.—Multiply the length of the pile in feet and inches, by the width, and that product again by the height of the pile, the last product is the solidity; which divided by 128 the quotient is cords; if any thing remains, divide it by 16, the quotient is feet of wood; if any thing still remains, divide by 4, the quotient will be quarters of a foot of wood, &c.

EXAMPLES.

1. What is the quantity of wood in a pile, that is 9 feet 6 inches long, 6 feet wide, and 4 feet 6 inches high?

ft. ft. ft. ft.

9 6′×6 0′×4 6′=256 6′÷128=2 cords ½ solid ft. Ans.

2. What is the solidity of a pile of wood 22 ft. 9 in. long, 5 ft. 8 in. wide, and 2 feet 6 inches high?

Ans. 2 † cords.

3. What is the solidity of a pile of bark that is 9 feet long, 10 ft. 6 in. high, and 4 ft. 6 in. thick?

Ans. 425¼ sol. ft. or 3 cords 2½† ft.

*Wood and bark are sold by the cord, and 1728 inches make 1 solid foot; 16 solid feet make 1 foot of wood; 8 feet of wood 1 cord; 128 solid feet one cord.

CASE XXV.

Having the base, or bottom of a pile of wood, or bark given, to find how high to build, that the pile may contain any quantity of wood, or bark required.

Rule.—Find the solid feet contained in the pile of wood you would build; reduce these feet to solid inches, and use them for a dividend; find the superficial area of the base in inches, and use them for a divisor; divide, and the quotient is the inches in height.

EXAMPLES.

1. How high must a pile of wood or bark be to contain 8 ft. or 1 cord; which stands upon a base 48 in. by 48 in.?

1 cord=128 sd. ft. ×1728=221184 sd. in. dividend.
48 in. ×48 in. =2304 area of the base, divisor.
221184÷2304=96 in. or 8 ft. in height, Ans.

2. I demand the height of a pile of wood that will contain 4½ feet, the base or bottom of which is 4 by 5 feet. Ans. $43\frac{576}{2880}$ in. or 3 ft. $7\frac{1}{5}$ in.

3. I demand the height of a pile of wood, that shall contain 9 feet, that stands upon a base that is 6 by 5 feet. Ans. $57\frac{2592}{432}$ in. or 4 ft. $9\frac{3}{4}$ in.

CASE XXVI.

To find the solidity of a parallelopipedon.

Definition.—A parallelopipedon is a figure having six rectangular sides, every opposite pair of which are equal and parallel.

Rule.—Multiply the length, breadth and thickness together, the product is the solidity.

EXAMPLES.

1. A farmer would make a large chest 21 ft. long, 5 ft. 6 in. wide, and 3 ft. 9 in. high, the solidity of which is required.

21 ft. 0 in.×5 ft. 6 in.×3 ft. 9 in.=433 ft. 1′ 6″. Ans.

2. How many solid feet in a cart that is 8 ft. long, 4 ft. 4 in. wide, and 2 ft. 4 in. high? Ans. 80 ft. 10′ 8″.

CASE XXVII.

To find the solidity of any cubical figure.

Definition.—Any figure having six square, or equal sides is called a cube.

Rule.—Multiply one side into another, and this product by the third, the last product is the solidity.

EXAMPLES.

1. What is the solidity of a tea chest that is 3 ft. 6 in. every way?

3 ft. 6′×3 ft. 6′ ×3 ft. 6′=42 ft. 10′ 6″. Ans. 6.

2. How many solid feet will 60 bales of goods occupy in a store; each bale measuring 4 ft. 3 in. every way? Ans. 4605 ft. 11′ 3″.

3. How many solid feet are in a square room that is 12 feet long, 12 feet wide and 12 feet high? Ans. 1728.

4. How many solid feet in a pillar that is 16 feet square? Ans. 4096.

5. There is a pit dug 8 feet deep, 8 feet long and 8 feet wide; how many solid feet of sand were thrown out of it? Ans. 512.

GUAGING.

Definition.—Guaging is the art of measuring all kinds of vessels, determining the quantity of liquor contained in them; practitioners in the art, generally make their calculations by means of instruments; the instruments used in guaging, are the calipers, Gunter's sliding rule, Gunter's scale, &c. the guaging rod is used to take, or find the outs. The vessels used for liquor

are various in shapes and names, viz. pipes, hogsheads, barrels, runlets, &c. also, among brewers, coolers, backs, vats, &c. are used.

Solidity of liquid measure, &c.

A gallon of wine occupies a space equal to 231 sol. in.
A gallon of beer occupies a space equal to 282 sol. in.
A gallon in corn measure is equal to 268·8 sol. in.
A bushel in corn measure is equal to 2150·4 sol. in.

Generally speaking there are three sorts of casks, which are judged of according to the curvature of their sides, viz.

1. If the sides of the cask are very curving from end to end, it may be said to represent the middle frustum of a spheroid, (see the figure E F G H, case 13, solids.)

2. If the sides of the cask are more straight it more properly represents the middle frustum of an eliptic spindle, (see the figure, case 14, solids.)

3. If the cask is straight from the end to the bung, and of a true taper, (such a cask is rarely found) it represents two frustums of a round cone; the two bases form the middle diameter. (See the frustum of a round cone, case 5, solids, figure first,) which represents half of such a cask.

GENERAL RULE.

Find the solidity of either of the above figures, (or any other figure) in solid inches, and divide the solidity by 231 for wine gallons; by 282 for beer gallons; and by 268·8 for gallons of grain or corn; and by 2150·4 for bushels of corn; and the quotients will be the answers respectively.

CASE I.

To guage a spheroidical cask.

RULE 1.—To twice the square of the bung diameter, add the square of the head diameter, and multiply the

sum by the length of the cask, divide the product by 882 for wine, by 1077 for ale, or beer, and by 1026·3 for gallons of corn or grain; and the quotients will be the answers respectively.

RULE 2.—Find the solidity of the cask by the following rule, viz. To the square of the diam. at the end, add twice the square of the middle, or bung diameter; multiply the sum by the length of the cask, and again by ·2618, the last product is the solidity; which divide by 231 for wine; 282 for ale, or beer; and by 268·8 for gallons of corn, or grain: the quotients will be the answers respectively.

EXAMPLE.

What is the content of a spheroidical cask, in wine, ale or beer and corn gallons; whose middle or bung diameter B D (see figure, case 13, solids) is equal to 20 inches, and the end diameter E G or F H is equal to 13 inches, and the length of the cask 22 inches?

Solved by rule first.

Bung diam. B D. $20 \times 20 \times 2 = 800$ twice the square.
Head diam. E G or F H $13 \times 13 = 169$ added.

sum $969 \times 22 = 21318$ pro.

Pro. $21318 \div 882 = 24\frac{150}{882}$ gal. of wine, Ans.
$21318 \div 1077 = 19\frac{855}{1077}$ gal. of ale or beer, Ans.
$21318 \div 1026·3 = 20\frac{7920}{10263}$ gal. of corn, &c. Ans.

The same question by rule second.

Diam. E G or F H $13 \times 13 = 169$ square of E G or F H.
Bung diam. B D $20 \times 20 \times 2 = 800$ twice square B D add.

969 sum.

Sum 969×22 length $= 21318 \times 2618 = 5581·0524$ sol.
Solidity $5581·0524 \div 231 = 24·16$† gal. of wine, Ans.
$5581·0254 \div 282 = 19·79$† gal. of ale, &c. Ans.
$5581·0524 \div 268·8 = 20·76$† gal. of corn, &c. Ans.

NOTE.—Dimensions are always taken in inches; due allowance must be made for the thickness of the heads, &c.

CASE II.

To guage a cask representing the middle frustum of an elliptic spindle.

RULE 1.—To twice the square of the bung diameter, add the square of the head diameter and reserve the sum; find the difference between the head and bung diameter, square the difference, and subtract $\frac{2}{5}$ of the square of the difference from the reserved sum; multiply the remainder by the length of the cask; divide the product by 882 for wine; by 1077 for ale or beer; and by 1026·3 for corn, &c.; the quotient will be the answers *in gallons* respectively.

RULE 2.—Find the solidity in solid inches by the following rule, viz. To the square of twice a diameter taken half way between the head and bung, (as at o P) add the squares of the head and bung diameters; multiply the sum by the length of the cask, and again by ·1309 for the solidity; divide the solidity by 231 for wine; and 282 for ale, or beer; and by 268·8 for corn, &c.; the quotients will be the answers in gallons respectively.

EXAMPLE.

What is the content of a cask representing the middle frustum of an elliptic spindle, (see figure E F, O P, C D, and G H, case 14, solids) in wine, ale, and corn gallons; whose length is 38; bung diameter C D 22; and end diameter E F, or G H. 16; and a diameter at O P 20·5 inches?

Solved by rule first.

Diam. C D $22\times22=484\times2=968$
Diam. E F or G H $16\times16=256$

reserved sum 1224
Diam. $22-16=6\times6=36\div\frac{2}{5}=14\cdot4$ sub.

remainder 1209·6
rem. $1209\cdot6\times38=45964\cdot8$ product.
pro. $45964\cdot8\div882\ \ =52\cdot1$† gal. wine, Ans.
$45964\cdot8\div1077\ \ =42\cdot6$† gal. ale, &c. Ans.
$45964\cdot8\div1026\cdot3=44\cdot7$† gal. corn, &c. Ans.

The same question by rule second.

Diam. at O P. 20·5 × 2 = 41 × 41 = 1681 square of twice O P.
Diam. C D 22 × 22 = 484 square of C D.
Diam. E F or G H 16 × 16 = 256 square of E F or G H.

2421 sum.

the sum 2421 × 38 × ·1309 = 12042·5382 solidity.
Solidity 12042·5382 ÷ 231 = 52·1† gal. wine, Ans.
12042·5382 ÷ 282 = 42·7† gal. of ale, &c. Ans.
12042·5382 ÷ 268·8 = 44·8† gal. of corn, &c. Ans.

CASE III.

To guage a cask representing two frustums of a round cone, the bases being joined together to form the bung diameter, (See figure 1, Case 5, Solids.)

Rule 1.—Add the two diameters together, square the sum and multiply the square by 3, and reserve the product; find the difference of the diameters; square the difference, and add the square of the difference to the reserved product, and multiply the sum by the length, and the product again by ·00023⅛ for ale, &c. by ·00028⅛ for wine.

Rule 2.—Find the solidity of half the cask by the following rule, (half of such a cask would represent a churn, or mash tub, or basket,) viz. Find the area of the two ends, supposing the cask to be cut in two, add the areas together and reserve the sum*; multiply the areas together, extract the square root of the product, and add the root to the reserved sum; multiply the sum by ⅓ the length and ⅓ the product is the solidity of half the cask, which must be doubled to make the solidity: divide the solidity by 231 for wine; 282 for ale; by 268·8 for corn gals. &c.

Note.—To find the area of the ends, multiply the diameter by the circumference, and ¼ of the product is the area.

EXAMPLE.

What is the content of a cask representing two

frustums of a cone, (see frustum A B C D, figure first, case 5, solids) diameter A B 31, and diameter, C D 44; length 55?

Solved by rule first.

res'd pro.

Diam. A B & C D 31+44=75×75=5625×3=16875

Diam. C D & A B 44—31=13×13=169 add.

Sum 17044

Sum 17044×55× ·00023⅓=217·48144 ale gal. Ans.

17044×55× ·00028⅓=265·60233 wine gal. Ans.

The same question by rule second.

As 7 : 22 : : 44 diam. : 138·3† circum.

7 : 22 : : 31 diam. : 97·4† circum.

Diam. 44×by cir. 138 3÷¼= 1521·3 area largest end.

Diam. 31×by cir. 97·4÷¼= 754·8† area of small end.

Areas. 2276·1 reserved sum.

$1521{\cdot}3\times754{\cdot}8=\sqrt[2]{1148277{\cdot}24}=1071{\cdot}5$ root added.

3347·6 sum.

Sum 3347·6× half length 27·5÷ ⅓ =30686·33 solidity of half the cask.

30686·33×2=61372·66 solidity of the cask.

solidity 61372·66÷282=217·6† ale gal. &c. Ans.

61372·66÷231=265·6† wine gal. Ans.

GUAGING, SECOND METHOD.

Sometimes the following method is used in guaging.

RULE.—Measure the diameter of the cask at both ends, and take half the sum for the head diameter; measure the diameter at the bung, or in the middle of the cask; (dimensions must be taken upon the inside, or else allowance must be made for the thickness of the staves, &c.); measure also the length of the cask; find the difference between the head and bung diameter; multiply it by ·62, and add the product to the head di-

ameter, the sum is the mean diameter of the cask; (and reduces it to a cylinder,) Square the mean diameter and multiply the square by the length of the cask, and divide by 294·12 for wine; by 359·05 for ale, &c.; by 342·25 for corn gallons; and by 2738 for bushels of corn.

NOTE.—These divisors arise by dividing 231, 282 and 268·8 by ·7854; if the square of the mean diameter were multiplied by the length and again by ·7854, the last product would be the solidity of the cask: (see Cylinder, case 4th, solids) the solidity being divided by 231 for wine; 282 for ale; by 268·8 for gallons of corn, &c. the quotients would be the answers in gallons, respectively; although the number ·62 is generally used by guagers, yet it ought to be varied according to the curvature of the cask; if the cask is very curving like figure, case 13th, solids, it would require that the difference between the diameters be multiplied by ·69 or ·7; if the cask is more straight the number used should be less.

EXAMPLES.

1. What is the content of a cask in form of the figure in case 13th, solids, whose diameter E G or F H equal 13, and diameter B D 20, and length 22 inches?

Diam. 20—13=7 dif. ×·70=4 90+13=1·79 mean diam. diam. 17·9×17·9×22=7049·02 product.

Product 7049·02÷294·12=24† gal. wine, Ans.
7049·02÷359·05=19† gal. ale, &c. Ans.
7049·02÷342·25=20† gal. of corn, Ans.

If the cask is more straight, the number ·67 ought to be used.

2. What is the content of a cask representing figure E F C B G H, case 14th solids; diam. E F or G H equal 16, diam. C D 22; length 38 inches?

Diam. 22—16=6 dif. × ·67=4·02+16=20·02 mean di.
Mean diam. 20·02 × 20·02=400·8004 × 38 len. =15230·4152 pro.

Pro. 15230·4152 ÷ 294·12=51† gal. wine, Ans.
15230·4152 ÷ 359·05=42† gal. ale, &c. Ans.
15230·4152 ÷ 342·25=44† gal. of corn, Ans.

3. What is the content of a cask, formed by joining two frustums of a round cone together, (the frustum A B C D figure first, case 5th, in solids, represents half of such a cask) diam. 44 and 31, and length 55 inches?

NOTE.—A cask of this form requires that the difference between the diameters be multiplied by ·515, for ·52 produces too much.

Diam. 44—31=13 dif. × ·515=6·695 × 31 diam.=37·695 mean diam.
Mean diam. 37·695 × 37·695 × 55=78150·216375 pro.
Pro. 78150·216375 ÷ 294·12=265·7† gal. wine, Ans.
78150·216375 ÷ 359·05=217·6† gal. ale, &c. Ans.

NOTE. It is evident from the three last examples, that the number ·62 would not exactly apply in either case: the dimensions of the the three last examples are the same as the dimensions of the three first examples, by the first method; and the numbers which I have made use of produce the same answers as were produced by the first method. If the cask is a little straighter than the elliptic spindle, in case 14 solids, the number ·62 will exactly apply: this number should always be varied according to the shape of the cask, and at the judgment of the guager.

4. What is the content of a spheroidical cask whose length is 20; diameters 16 and 12 inches?

Ans. 14·8† wine, 12·2† ale, &c.

In this example the number ·7 is used.

5. What is the content of a cask representing an elliptic spindle, length 40; diameters 32 and 24?

Ans. 117·2† wine, 96·0† ale, &c.

In this example the number ·67 is used.

6. What is the content of a cask, representing two frustums of a cone, diam. 24 and 32; length 40?

Ans. 107·5† wine. 88·09† ale, &c.

In this example the number ·515 is used.

To guage with calipers, or Gunter's scale.

On the calipers there is a brass pin fixed at the points 17·15 and at 18·95;* these are called guage points; 17·15 is used for guaging wine, and 18·95 is used for ale, or beer, &c.

Rule.—For a cask representing the middle frustum of a spheroid, (see figure, case 13, solids) extend from 1 to ·7; and with the same extent, set one foot of the dividers in the number expressing the difference between the bung and head diameter, and they will reach to a number, towards the left hand, which, when added to the head diameter will give the mean diameter of the cask; then set one foot of the dividers in the guage point, and extend to the mean diameter; and the same way set off twice that extent from the length of the cask, and they will reach to a number expressing the content of the cask.

Note 1.—The same operation may be performed on the line of numbers, on Gunter's scale.

Note 2.—If wine gallons are required, use the guage point 17·15; if ale gallons are required, use the guage point 18·95; and if corn gallons are required, you may use the point 18·5 respectivley.

Note 3.—If the cask represents the middle frustum of an elliptic spindle, (see figure, case 14, solids) extend from 1 to ·67, or if a little more straight, extend from 1 to ·62; and for a cask formed by two frustums of a cone, extend from 1 to ·51 or ·52.

EXAMPLES.

1. What is the content of a cask of rum, or wine, whose length is 59·3 in.; and diameters 34·5, and 30·7; difference of diameters 3·8?

Operation.

Extend from 1 to ·62; and that extent reaches from 3·8, (the difference of the diameters) towards the left

* These numbers are the square roots of the numbers 291·12 and 359·05 respectively.

hand to 2·4 nearly, which add to the head diameter; $30{\cdot}7+2{\cdot}4=33{\cdot}1$ mean diam.; then extend from the guage point 17·15 to 33·1 (the mean diameter,) and set off twice that extent from 59·3 (the length of the cask,) and they will reach to 220·8 nearly, which is the content of the cask.

2. What is the content of a cask of wine whose length is 38; diam. 22, and 16 in.: difference of diameters 6? Ans. 52† wine, 42† ale, &c.

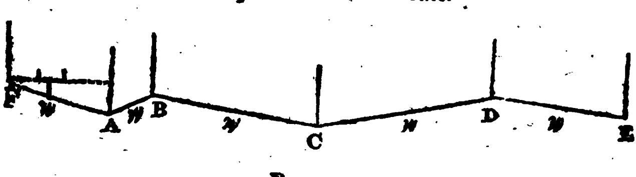
Operation.

Extend from 1 to ·67; and that extent will reach from 6, (the difference) to 3·7 nearly: which being added to the head diameter 16, produces 19·7 for the mean diameter: then extend from the wine guage point to 19·7, (the mean diameter) and set off twice that extent from 38, the length; and the dividers will rest on 52 the answer.

NOTE. Guagers make use of the guaging rod to take the dimensions of the cask; and there are also tables on it by means of which the outs are taken; after the preceding rules are well committed to memory, the young practitioner would soon obtain a complete knowledge of guaging, by a little practice with the instruments.

WATER LEVELLING.

To find whether water can be made to run from one place to another, or to find how much higher one place is than another.



F is the fountain, and E the place assigned to carry the water to.

NOTE.—To perform this business you must be provided with two staves divided into inches and tenths, which may be of any convenient length, perhaps 4 or 6 feet; and also a water level which may be made easily at any Joiner's shop; the level may be of any convenient length, dug out hollowing, so as to hold water; with two sights at the top to make the observation through: having provided the staves and water level, go to the fountain with two assistants and observe the following rule.

RULE.—Order the first assistant to the fountain with one staff placed perpendicularly: and the second assistant to any convenient place as at A, with his staff perpendicularly; then place the water level in the middle between them at *w*, and looking through the sights order the first assistant to move a piece of white paper up and down the staff till you can see it through the sights; then order him to notice the distance it rests from the ground; and going to the other end of the water level, order the second assistant to do likewise; and after he has marked down the distance the papers rest from the ground, order the first assistant to take the place of the second, and the second to take a new stand as at B; place the water level between them, make observations as before, and order the assistants to mark down the distances the paper rests from the ground, and proceed to take another station and make new observations till you have arrived to the place assigned; then order the assistants to cast up their notes,

and as much as the second assistant's notes exceed the first, so much does the ground descend; and so much as the second assistant's notes are less than the first, so much does the ground rise. In the preceding example the assistant's notes are as follows:

First assistant's notes	ft.	in.	Second assistant's notes.	ft.	in.
First station	0	7	First station	1	0
Second do.	1	0	Second do.	0	6
Third do.	0	2	Third do.	1	6
Fourth do.	1	2	Fourth do.	0	2
Fifth do.		4	Fifth do.	0	7
ft.	3	3 in.	ft.	3	9 in.

Second assistant's notes exceed the first by 6 inches; of course the ground is 6 inches lower at E, than at F, and water will run.

APPENDIX.

Of Grindstones.

Grindstones are sold by the cubic foot, commonly called a stone, to find the contents of which the following rule is used.

RULE.—To the diameter of the stone add its semidiameter, multiply the sum by the semi-diameter, and multiply the last product by the thickness; divide by 1728, the quotient is the content of the stone.

N. B. The dimensions are to be taken in inches.

EXAMPLES.

1. What is the content of a stone whose diameter is 40 inches, and is 6 inches thick; and what will it come to at ·75 cts. per cubic foot?

$$\overset{diam.}{40}+\overset{semi.\,di}{20}=\overset{s.\,diam.}{60\times20}=1200\times\overset{thick.}{6}=7200\div1728=4{\cdot}16\dagger\text{con. Ans}$$

$$4{\cdot}16\times{\cdot}75=\$3{\cdot}12\ \text{value, Ans.}$$

2. What will the following grindstones come to, at ·70 cts. per cubic foot; one whose diameter is 30 inches, 5 inches thick; one 36 inches diameter, 4 inches thick; one 40 inches diameter, 4 inches thick; and one 60 inches diameter, and 6 inches thick?

$30+15=45\times15=\ 675\times5=\ 3375$
$36+18=54\times18=\ 972\times4=\ 3888$
$40+20=60\times20=1200\times4=\ 4800$
$60+30=90\times30=2700\times6=16200$

Content in cubic inches 28263

Cubic in. *Cubic ft. Cts.*
$28263\div1728=16{\cdot}35\dagger\times{\cdot}70=\$11{\cdot}44\frac{1}{2}$ cts. Ans.

To reduce Sterling Money to Federal.

N. B. The rule for reducing Sterling money to Federal, mentioned in page 142, is used at the Custom Houses in the United States, where a pound sterling is estimated at \$4·44, agreeable to an act of Congress, by which act it is enacted, that in the payment of duties a pound sterling of Great Britain shall be estimated at \$4·44, but merchants make use of the following Rule to reduce Sterling money to Federal, which makes a pound sterling equal to $\$4{\cdot}44\frac{4}{9}$.

Rule.—To the sum in pounds annex three cyphers, multiply the whole by 4, divide the product by 9, the quotient will be Federal money in cents.

If the sum consists of pounds, shillings, &c. reduce the sterling to the former currency of New-England by adding $\frac{1}{3}$ of the sum to itself, then reduce the sum to Federal money by the rule in page 135.

EXAMPLES.

1. Reduce 360 pounds sterling to Federal money.
$360000\times4=1440000\div9=160000$ cts.$=\$1600$ Ans.

2. Reduce £125 16 9 sterling to Federal money.

	£.	s.	d.	
$\frac{1}{3}$)	125	16	9	
	41	18	11	$\frac{1}{3}$ added.
	167	15	8	N. E. Currency.
	1677	5		
		·33		
$\frac{1}{3}$)	1677·83			
	559·27$\frac{2}{3}$			Federal money, Ans.

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ALTHOUGH systems of Book-Keeping are numerous, yet it is seldom that any of them get into any of our country schools; and it is very common to find young men, *sons of reputable* Farmers, Mechanicks, and Tradesmen, who have never seen a system of Book-Keeping; and when they become of age and enter upon business for themselves, they have to contrive some system for their own use. Having frequently seen instances of this kind, I thought a short practical system of Book-Keeping, suitable for Farmers, Mechanicks, and Retailers, would, by being thrown into the hands of boys in our country schools, conduce greatly in removing the ignorance of that useful science, which so generally prevails. THE AUTHOR.

Merchants have various methods of keeping their Books, and many of them keep various Books, such as the Blot-Book, Waste-Book, Day-Book, Ledger, Bill-Book, Sales-Book, Cash-Book, Invoice-Book, &c.; but as this system is designed for Farmers, Mechanicks, and Traders, I shall treat of two books only, viz. the Day-Book and Ledger, these being all that are necessary for that part of the community for which this work is intended.

Of the Day-Book.

Begin your Day-Book with an account or invoice of all your property; charge yourself with all the estate

you are in possession of, either real or personal, and credit the same account with all the debts you owe, whether on note or account, and the difference between the debtor and credit side of this account will shew the situation or value of your estate when you commenced business.

When you sell any thing to any person on credit, enter the purchaser *Debtor* in the Day-Book. To the articles sold, naming the month, year, and day of the month; the quantity and price of the article or articles sold and to whom delivered should be particularly noticed; and if any particular time or any particular manner of payment is agreed upon, it is best to name the circumstances with the charge: if you buy goods of any person enter the person of whom you purchase *Creditor*. By the articles purchased, naming every circumstance agreed upon, time of payment, &c.

Keep an account of all the notes or other instruments you sign, whereby you consider yourself liable to pay; that you may know all the demands against you; and your stock of goods on hand, your notes and balances of your accounts taken at any time when you please, will enable you to ascertain whether you are gaining or losing by your business.

The following examples will illustrate the process, and give the scholar an idea of commencing business, and from time to time to ascertain whether his business is profitable or not.

Abel Flint, a farmer, enters on business in circumstances as follows:

Date	Account	Dr.	Dols. Cts.
	Abel Flint,	**Dr.**	
A. D. 1817. Dec. 1.	To sundry goods and chattels belonging to him the first day of December, A. D. 1817, valued as follows, *viz.*		
	100 acres of land,	$1000	
	4 oxen,	100	
	1 pair wheels, cart, &c.	50	
	1 plough and 1 harrow,	15	
	20 sheep,	40	
	1 horse,	40	
	90 bushels of corn and grain,	90	
	Pork, beef, beans, hay, &c.	180	
	Stephen Goodhue owes me	90	
	Stephen Beedle owes me	150	
	Nathan Hoag owes me	650	2405·00
	Contra,	**Cr.**	
	By sundry debts due from me to sundry persons, December 1, 1817, *viz.*		
	Due to Peter Wilberforce towards my farm,	$650	
	Due to Seth Wright,	80	
	Due to Nathan Lookout,	122	852·00
			1553·00
	Neat of my estate December 1, 1817, after deducting all demands against it, including interest, &c.	$1553·00	

A. D. 1818.			Dols. Cts.
March 20.	**Trustum Ayer,** *of Chester,* **Dr.**		
*	To two bushels corn, at 7*s*.6*d*.	$2·50	
	" six bushels potatoes, 1*s*.6*d*.	1·50	
	" fifteen lbs. cheese, 9*d*.	1·87½	5·87½
	Payable in labour at 50 cts. per day, on demand.		
	David Briant, *of Exeter,* **Dr.**		
" 23. *	To twenty lbs. of flax, at 16 cts.	3·20	3·20
	Enoch Calhound, *of Lee,* **Dr.**		
" 26. *	To twenty lbs. flax, at 16 cts.	$3·20	
	" twenty lbs. lambs wool 30 cts.	6·00	
	" four bushels corn 1·25 "	5·00	
	" ten bushels potatoes, 25 "	2·50	19·70
	Trustum Ayer, *of Chester,* **Cr.**		
" 29. *	By twelve days labour, at 50 cts.	$6·00	6·00
	Contra, Dr.		
	To four bushels corn, at 1·25	$5·00	
*	" one and half bushels white beans, at 1·50	2·25	7·25
	Enoch Calhound, *of Lee,* **Dr.**		
" 30 *	To four bushels of corn, at 1·25	$500	5·00
	Tho's. Dwight, *of Chester,* **Cr.**		
A. D. 1818. June 9. *	By seven thousands of shingles, at $2 per thousand, payable in salt at 75 cents per bushel, delivered at Exeter the third day of August next.		14·00

A. D. 1818.		Dolls. Cts.
July 30.	**Enoch Calhound,** *of Lee,* **Dr.**	
*	To two barrels cider, at 2·50	5·00
	Thomas, Ingals *of Exeter,* **Dr.**	
" 31. *	To one bushel corn, at 1·25 $1·25 " four bushels potatoes 25 1·00	2·25
A. D. 1818.	August, A. D. 1818.	
	Thomas Ingals, *of Exeter,* **Dr.**	
August 1. *	To one pig, six weeks old, at 1·50	1·50
	Trustum Ayer, *of Poplin,* **Dr.**	
" 20. *	To one barrel cider, at 2·50 $2·50 " one bushel corn, 1·25 1·25 " half bushel white beans 2·50 1·25	5·00
	Enoch Calhound, *of Lee,* **Dr.**	
" 29. *	To pasturing a horse six weeks,	6·00
	David Briant, *of Exeter,* **Dr.**	
29. *	To my horse and chaise to Portsmouth,	1·25
	Tristum Ayer, *of Chester,* **Dr.**	
" 30. *	To myself and four oxen, to hall salt from Exeter to Chester two days, at $2 per day,	4·00
	Enoch Calhound, *of Lee,* **Cr.**	
" 31. *	By cash received by the hand of Nathan Briand,	15·00

A.D.1818.	**Thomas Ingals,** *of Exeter,* **Dr.**		*Dols. Cts.*
August 31.	To one bushel of corn, at 1·25	$1·25	
	" one do. rye, 1·50	1·50	
*	" two do. potatoes, ·25	·50	3·25
Dec. 10.	**Trustum Ayer,** *of Chester,* **Dr.**		
*	To six gallons vinegar, at 33 cts.		1·98
	Thomas Ingals, *of Exeter,* **Dr.**		
" 10.	To one pair men's shoes, at 1·75	$1·75	
	" one peck white beans, 1·48	·37	
*	" one bushel rye, 1·50	1·50	
	" three do. corn, 1·25	3·75	7·37
" 20.	**David Briant,** *of Exeter,* **Dr.**		
*	To twenty lbs. butter, at 18cts.	$3.60	
	" thirty lbs. cheese, ·10	3·50	
	two barrels cider, 2·25	5·00	12·10
" 31.	**Thos. Dwight,** *of Chester,* **Dr.**		
*	To 18⅔ bushels salt, in full payment for 7 thousand shingles, purchased of him, June 9, 1818, at ·75 cts.		14·00
" 31.	**Thomas Ingals,** *of Exeter,* **Dr.**		
*	To 12 days myself and four oxen, at 2·00		24·00

OF THE LEDGER.

The Ledger collects the dispersed accounts of the Day-Book, and shows each man's account on a page; the debt on the left hand, and the credit on the right.

Open an account *in the Ledger for every* person whose name is mentioned in the Day-Book, head the account with the person's name, in a large round hand; then on the left hand page make him Dr. to the several sums you find charged to him in the Day-Book; and on the right hand page give him Cr. by the amount of all you find by the Day-Book you have purchased of him; thus each man's account will be exhibited to view on a page in the Ledger.

Of Posting the Day-Book into the Ledger.

Some in Posting, enter every article found in the Day-Book into the Ledger; but this method not only takes up too much room in the Ledger, but is too tedious in its operation. The better way is to collect together in one sum the several items on one page in the Day-Book, and enter the sum in the Ledger; observing to note in the Ledger, the page of the Day-Book, from whence the sum was taken; if the charges are but few in the Day-Book, they may be named in short in the Ledger; make some mark, in the margin of the Day-Book, for a Post-mark,* that you may know when you have taken off each man's account.

* This * or any other mark may be used.

ALPHABET TO LEDGER A.

Make an Alphabet, in which, enter each man's name Alphabetically, for the more readily finding each man's account in the Ledger, naming in the Alphabet the page or pages of the Ledger, where the account may be found.

Form of the Alphabet.

	page.		page.
A. Ayer Trustum	1	G.	
B. Briant David	1	H.	
C. Calhound Enoch	2	I. Ingals Thomas	2
D. Dwight Thomas	2	J.	
E.		K.	
F. Flint Abel, stock act.	1	L.	

A. D. 1817.	Abel Flint, stock account, Dr.	Page D. B.	
Dec. 1.	To the Inventory of my estate, Dec. 1, 1817,		Dols. Cts. 2405·00
A. D. 1818. Dec. 1.	To the Inventory of my estate, Dec. 1, 1818,		Dols. Cts. 2779·63

A. D. 1818.	Trustum Ayer, *of Chester*, Dr.		
March.	To corn, potatoes, cheese and beans, - - -	2	13·12½
August.	" cider, corn, beans and team,	3	8·62½
December.	" vinegar, - - - -	4	1·98
			$23·73

A. D. 1818.	David Briant, *of Exeter*, Dr.		
March.	To flax, - - - - -	2	3·20
August.	" horse and chaise to Portsmouth,	3	1·25
December.	" butter, cheese and cider,	4	12·10
			$16·55

A. D. 1817.	Contra.	Cr.	
		Page D.B.	Dol. cts.
December.	By sundry debts due from me Dec. 1, 1817,	1	852·00
	" neat of my estate, Dec. 1, 1817, after deducting all debts,		1553·00
			2405·05
	" sundry debts due from me Dec. 1, 1818,		773·80
	" neat of my estate, Dec. 1, 1818, after deducting all demands,		2005·83
			2779·63

A. D. 1818.	Contra.	Cr.	
March.	By labour, - - - -	2	6·00
	" a note for balance, -		17·73
			$23·73

Exeter, January 1, 1819.—Then reckoned and settled all Book accounts between the subscribers and find due to Abel Flint seventeen dollars and seventy-three cents, and settled the same by note.
Trustum Ayer,
Abel Flint.

A. D. 1818.	Contra.	Cr.	
December.	By a note for the balance of accounts, - -		$16·55

Exeter, December 1, 1818.—Then reckoned and settled all book accounts between the subscribers, and find due to Abel Flint sixteen dollars and fifty-five cents; paid the same by a note.
David Briant,
Abel Flint.

A. D. 1818.	Enoch Calhound, *of Lee*, Dr.	Page D.B.	Dol. cts.
March.	To flax, wood, corn and potatoes,	2	20·95
July.	" cider, and pasturing horse,	3	11·00
			$31·95
	" balance due on settlement, Dec. 1, 1818.		16·95

A. D. 1818.	Thomas Dwight, *of Chester*, Dr.		
March.	To eighteen and two thirds bushels salt,	4	14·00

A. D. 18[illegible]	Thomas Ingals, *of Exeter*, Dr.		
July, Au.	To corn, potatoes and pig,	3	3·75
Dec.	" corn, rye, potatoes, shoes, beans and teaming,	4	34·62
			$38·37

A. D. 1818.	Contra.		Cr.
		Page D.B.	Dol. cts.
August.	By cash received by the hand of N. Briant, -	3	15·00
	" balance due on settlement,		16·95
			$31·95

Exeter, December 1, 1818. Then reckoned and settled all accounts between the subscribers, and find due to Abel Flint sixteen dollars ninety-five cents, to make even balance.

Enoch Calhound,
Abel Flint.

A. D. 1819.	Contra.		Cr.
March.	By seven thousand shingles,	2	14·00

A. D. 1818.	Contra.		Cr.
Dec.	By balance paid on settlement,		38·37
			$38·37

Exeter, December 20, 1818. Then reckoned and settled, and made even all accounts to this date.

Thomas Ingals,
Abel Flint.

Inventory of goods, debts, and money belonging to me, Abel Flint, December 1, 1818, *and also of what I owe.*

	I have in cash on hand,	$125·00	
100	Acres of land,	1000·00	
6	Oxen,	180·00	
30	Sheep,	60·00	
2	Horses,	100·00	
120	Bushels corn and grain,	120·00	
	Pork, beef and hay,	200·00	
	Trustum Ayer's note,	17·73	
	David Briant's note,	16·55	
	Bal. of Enoch Calhound's account,	16·95	
	Nathan Hoag's note,	650·00	
	Interest on said note one year,	39·00	
	Stephen Goodhue's note,	90·00	
	Interest on said note one year,	5·40	
	Stephen Beadle's note,	150·00	
	Interest on said note one year,	9·00	
			2779·63

Inventory of all the debts I owe, Dec. 1, 1818.

Due to Peter Wilberforce,	650·00	
Interest on the same one year,	39·00	
Due to Seth Wright,	80·00	
Interest on the same one year,	4·80	
		773·80
Neat of my estate,		$2005·83

STANDARD OF FOREIGN GOLD.

A TABLE for paying and receiving the Gold Coins of GREAT-BRITAIN *and* PORTUGAL, *of their present value.—According to an act of Congress, passed April,* **29, 1816** ; *by which act the standard was fixed at* **88⅛** *cents to the Dwt. or* **27** *grains to the dollar.*

Grs	Dol Ct.	Grs	Dol Ct.	Grs.	Dol. Ct.	Grs.	Dol. Ct.	Gr.	Dol Ct
1	4	6	22	11	41	16	59	21	78
2	7	7	26	12	44	17	63	22	81
3	11	8	30	13	48	18	67	23	85
4	15	9	33	14	52	19	70	24	89
5	19	10	37	15	45	20	74		

Dwts.	Dol. Cts.	Dwts.	Dol. Ct.	Dwts.	Dol. Cts.	Dwts.	Dol. Cts.	Dwt.	Dol. Cts.
1	89	21	18 67	41	36 44	61	54 22	81	72 00
2	1 78	22	19 55	42	37 33	62	55 11	82	72 89
3	2 67	23	20 44	43	38 22	63	56 00	83	73 78
4	3 55	24	21 33	44	39 11	64	56 89	84	74 67
5	4 44	25	22 22	45	40 00	65	57 78	85	75 55
6	5 33	26	23 11	46	40 89	66	58 67	86	76 44
7	6 22	27	24 00	47	41 78	67	59 56	87	77 33
8	7 11	28	24 89	48	42 67	68	60 44	88	78 22
9	8 00	29	25 78	49	43 55	69	61 33	89	79 12
10	8 89	30	26 67	50	44 44	70	62 22	90	80 00
11	9 78	31	27 55	51	45 33	71	63 11	91	80 89
12	10 67	32	28 44	52	46 22	72	64 00	92	81 78
13	11 55	33	29 33	53	47 11	73	64 89	93	82 67
14	12 44	34	30 22	54	48 00	74	65 78	94	83 55
15	13 33	35	31 11	55	48 89	75	66 67	95	84 44
16	14 22	36	32 00	56	49 78	76	67 55	96	85 33
17	15 11	37	32 89	57	50 67	77	68 44	97	86 22
18	16 00	38	33 78	58	51 55	78	69 33	98	87 11
19	16 89	39	34 67	59	52 44	79	70 22	99	88 00
20	17 78	40	35 55	60	53 33	80	71 11	100	88 89

Dwts.	Dol. Cts.	Dwts.	Dol. Cts.
200	177 78	2000	1777 78
300	266 67	3000	2666 67
400	355 55	4000	3555 55
500	444 44	5000	4444 44
600	533 32	6000	5333 33
700	622 22	7000	6222 22
800	711 11	8000	7111 11
900	800 00	9000	8000 00
1000	888 89	10000	8888 89

A TABLE shewing the weight of any sum of English or Portuguese Gold, from 1 to 90 dollars.

Dol.	Dwts.	Grs.	Dol.	Dwts.	Grs.	Dol.	Dwts.	Grs.
1	1	3	7	7	21	40	45	00
2	2	6	8	9	00	50	56	6
3	3	9	9	10	3	60	67	12
4	4	12	10	11	6	70	78	18
5	5	15	20	22	12	80	90	00
6	6	18	30	33	18	90	101	6

STANDARD OF FOREIGN GOLD.

A TABLE for receiving and paying the Gold Coins of FRANCE, *of their present standard.—According to an act of Congress, passed April* 29, 1816; *by which act the standard was fixed at* 87½ *cents to the Dwt. or* 27½ *grains to the dollar.*

Grs	Dol Ct.	Grs	Dol Ct.	Grs.	Dol. Ct.	Grs.	Dol. Ct.	Gr.	Dol Ct
1	4	6	22	11	40	16	58	21	76
2	7	7	25	12	44	17	62	22	80
3	11	8	29	13	47	18	65	23	83
4	15	9	33	14	51	19	69	24	87
5	18	10	36	15	55	20	73		

Dwts.	Dol. Cts.	Dwts.	Dol. Ct.	Dwts.	Dol. Cts.	Dwts.	Dol. Cts.	Dwt.	Dol. Cts
1	87	21	18 32	41	35 77	61	53 22	81	70 67
2	1 75	22	19 19	42	36 65	62	54 09	82	71 55
3	2 62	23	20 07	43	37 52	63	54 97	83	72 42
4	3 49	24	20 94	44	38 39	64	55 84	84	73 29
5	4 36	25	21 81	45	39 26	65	56 71	85	74 16
6	5 23	26	22 69	46	40 12	66	57 59	86	75 03
7	6 11	27	23 56	47	41 01	67	58 46	87	75 91
8	6 98	28	24 43	48	41 88	68	59 33	88	76 78
9	7 85	29	25 30	49	42 75	69	60 20	89	77 65
10	8 73	30	26 17	50	43 68	70	61 07	90	78 53
11	9 60	31	27 05	51	44 50	71	61 95	91	79 40
12	10 47	32	27 92	52	45 37	72	62 82	92	80 27
13	11 34	33	28 79	53	46 24	73	63 69	93	81 14
14	12 21	34	29 67	54	47 11	74	64 57	94	82 01
15	13 09	35	30 54	55	47 99	75	65 44	95	82 89
16	13 96	36	31 41	56	48 86	76	66 31	96	83 76
17	14 83	37	32 28	57	49 73	77	67 18	97	84 63
18	15 71	38	33 15	58	50 61	78	68 05	98	85 51
19	16 58	39	34 03	59	51 48	79	68 93	99	86 38
20	17 45	40	34 90	60	52 35	80	69 80	100	87 25

Dwts.	Dol. Cts.	Dwts.	Dol. Cts.
200	174 50	2000	1745 00
300	261 75	3000	2617 50
400	349 00	4000	3490 00
500	436 25	5000	4362 50
600	523 50	6000	5235 00
700	610 75	7000	6107 50
800	698 00	8000	6980 00
900	785 25	9000	7852 50
1000	872 50	10000	8725 00

A TABLE shewing the weight of any required sum of French Gold from 1 to 90 dollars.

Dol.	Dwts.	Grs.	Dol.	Dwts.	Grs.	Dol.	Dwts.	Grs.
1	1	4	7	8	1	40	45	20
2	2	7	8	9	4	50	57	7
3	3	11	9	10	8	60	68	18
4	4	14	10	11	11	70	80	5
5	5	18	20	22	22	80	91	16
6	6	21	30	34	9	90	103	3

STANDARD OF FOREIGN GOLD.

A TABLE for receiving and paying the Gold Coins of Spain *and the* Dominions *of* Spain, *of their present standard.—According to an act of Congress, passed April 29,* 1816 *; by which act the standard was fixed at* 84 *cents to the Dwt. or* 28½ *grains to the dollar.*

Grs	Dol Ct.	Grs	Dol Ct.	Grs.	Dol. Ct.	Grs.	Dol. Ct.	Gr.	Dol Ct.
1	3	6	21	11	39	16	56	21	73
2	7	7	25	12	42	17	59	22	77
3	11	8	28	13	45	18	63	23	81
4	14	9	31	14	49	19	67	24	84
5	17	10	35	15	53	20	70		

Dwts.	Dol. Cts.	Dwts.	Dol. Ct.	Dwts.	Dol. Cts.	Dwts.	Dol. Cts.	Dwts.	Dol. Ct.
1	84	21	17 64	41	34 44	61	51 24	81	68 04
2	1 68	22	18 48	42	35 28	62	52 08	82	68 88
3	2 52	23	19 32	43	36 12	63	52 92	83	69 72
4	3 36	24	20 16	44	36 96	64	53 76	84	70 56
5	4 20	25	21 00	45	37 80	65	54 60	85	71 40
6	5 04	26	21 84	46	38 64	66	55 44	86	72 24
7	5 88	27	22 68	47	39 48	67	56 28	87	73 08
8	6 72	28	23 52	48	40 32	68	57 12	88	73 92
9	7 56	29	24 36	49	41 16	69	57 96	89	74 76
10	8 40	30	25 20	50	42 00	70	58 80	90	75 60
11	9 24	31	26 04	51	42 84	71	59 64	91	76 44
12	10 08	32	26 88	52	43 68	72	60 48	92	77 28
13	10 92	33	27 72	53	44 52	73	61 32	93	78 12
14	11 76	34	28 56	54	45 36	74	62 16	94	78 96
15	12 60	35	29 40	55	46 20	75	63 00	95	79 80
16	13 44	36	30 24	56	47 04	76	63 84	96	80 64
17	14 28	37	31 08	57	47 88	77	64 68	97	81 48
18	15 12	38	31 92	58	48 72	78	65 52	98	82 32
19	15 96	39	32 76	59	49 56	79	66 36	99	83 16
20	16 80	40	33 60	60	50 40	80	67 20	100	84 00

Cts.	Dol.	Cts.	Dol.
200	168	2000	1680
300	252	3000	2520
400	336	4000	3360
500	420	5000	4200
600	504	6000	5040
700	588	7000	5880
800	672	8000	6720
900	756	9000	7560
1000	840	10000	8400

A TABLE shewing the weight of any sum of Spanish Gold from 1 *to* 90 *dollars.*

Dol.	Dwts.	Grs.	Dol.	Dwts.	Grs.	Dol.	Dwts.	Grs.
1	1	5	7	8	8	40	47	15
2	2	9	8	9	13	50	59	13
3	3	14	9	10	17	60	71	10
4	4	18	10	11	22	70	83	8
5	5	23	20	23	19	80	95	6
6	6	04	30	35	17	90	107	3

FORM OF AN ACCOUNT CURRENT.

Dr. Mr. Samuel Gorham of Portsmouth, in account current with Mr. John Laird, of Exeter. *Cr.*

A. D. 1811.			A. D. 1811.		
June 20.	To 6 barrels flour, at $10 per bar.	$60·00	Sept. 19.	By cash, - - -	$61·20
July 11.	" 1 cwt. sugar at $15 per cwt.	15·00	Nov. 11.	By an order on Mr. A. B. -	15·16
do. 19.	" cash paid J. Dirgan per order.	10·00	Dec. 21.	By cash by the hand of J. Orr,	29·76
Aug. 20.	" sundries as per bill, - - - -	26·93	do. 24.	By repairing my chaise, -	21·70
do. 29.	" goods deliv. to A. B. per order,	29·25			
Sept. 6.	" 1 bar. rum, 32½ gal. at $1·20 cts.	39·00	A. D. 1812.		
Oct. 10.	" 42 gal. molasses at 56 cts. - - -	23·52	Jan. 15.	By cash by the hand of J. Orr,	101·63
Dec. 21.	" 2½ cwt. of iron at $5·50 cts. -	13·75			
do. 29.	" 60 lbs. sugar at 10 cts. - - -	6·00			$229·45
		$229·45			

Exeter, 15th January A. D. 1812.

Errors excepted.

John Laird.

When a person is furnished with his account current, the various charges should be specified, and the dates when the articles were delivered, when the articles are numerous, some Accountants make but one charge in the account current, referring to an annexed account of the several articles included.

USEFUL FORMS OF WRITINGS.

Form of a Bill of Exchange.

Portsmouth, (N. H.) April 1, 1814.

Exchange for £650 sterling.

At sixty days sight of this my first of exchange (second and third of the same tenor and date not paid) pay to W. Richards, or order, six hundred and fifty pounds sterling with, or without former advice from

Your humble servant,

James Jackson.

Messrs. Corridon & Cutler,
Merchants, Bristol.

OF NOTES.

Form of a Note by person.

Newburyport, April 1, 1814.

For value received I promise to pay to John Laird, or order* three hundred and sixty-seven dollars, and twenty-five cents, on demand, with interest, witness my hand. Seth Brookings.

$367·25.

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* A Note is not negotiable unless the words, *or order*, or the words *or bearer*, are inserted. If it is written to pay J. L. *or order*, then J. L. may write his name on the back side, and sell it to A. (or any one else) then A. who buys the note may call on Seth Brookings for the payment of the same, and if he is unable, or neglects to pay it, A. may recover the same of J. L. If the note were written to pay John Laird, *or bearer*, then any person may recover the same of Seth Brookings.

Further observations concerning notes.

All notes are either payable on demand, or at a certain time mentioned in the note; all notes payable at a certain time are on interest as soon as they become due, although interest is not mentioned in the note; a note payable on demand, will draw interest after a demand

Another form of a note.

I promise to pay Aaron Kimball, or order one hundred dollars, on demand with interest, after ninety days, for value received at Exeter this first day of April, A. D. 1814. Witness my hand. Roger Perkins.

$100·00

Form of a note given by two or more persons jointly and severally.

Exeter, April, 1, 1814.

For value received, we the subscribers promise jointly and severally to pay Andrew Fairbanks, or order one hundred dollars in one year from the date, with interest.

Witness our hands. James Rush,
Thomas Sutton.

$100

OF RECEIPTS.

The form of a receipt for money received on account.

Hallowell, April 10, 1814.

Received of Isaac Sewall sixty-eight dollars on accompt. Lemuel Lovejoy.

The form of a receipt for an endorsement on a note.

Augusta, April 10, 1814.

Received from David Goodhue one hundred and eighty dollars, by the hand of James Osgood, which is endorsed on his note of June 12, 1813. W. Speare.

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of payment is made, if interest is not mentioned in the note. If a note is given for any commodity, as corn, lumber, &c. payable at the expiration of a certain time, and the signer of the said note does not hold the article ready, or does not pay it at the time it is demanded, the holder of the note is not obliged to take the article, but may demand, and recover the value of the article in money.

*The form of a receipt in full of all accounts.**

Portland, April 10, 1814.

Received of Stephen Hammons six dollars in full of all accounts. John Birdseye.

The form of a receipt in full of all demands.

Kennebunk, April 10, 1814.

Received of Lemuel Osgood six dollars in full of all demands to this date. Enoch Goodroy.

OF ORDERS.†

Waterville, March 10, 1810.

For value received pay to Stephen Hingham ten dollars, and place the same to my account.

To Mr. Alfred Goodpay. Abner Drew.

Another form.

Waterville, April 10, 1814.

For value received pay Nathan Livingston six dollars, and this with his receipt shall be your discharge.

To Mr. Stephen Skinner. Lemuel Needy.

OF DEEDS.

Form of a Warrantee Deed.

KNOW ALL MEN BY THESE PRESENTS, THAT I WILLIAM TRUSTY, of Exeter, County of Rockingham, State of New-Hampshire, Gentleman, in the consideration of the

* There is a distinction to be made between a receipt given in full of all accounts, and one given in full of all demands; the former will cut off accounts only, but the latter will cut off all obligations, and prohibit the right of an action.

† The words *For value received*, should always be mentioned in an order, then if A should give B an order on C for a certain sum of money; and C should not accept the order, B could sue A for the order, and recover the same, as well as if it had been a note of hand.

sum of six hundred dollars, paid me by William Hadley of the same Exeter, yeoman, the receipt whereof I do hereby acknowledge, do hereby give, grant, bargain, sell and convey unto the said William Hadley, his heirs and assigns forever (*here insert the premises, particularly describing the town, county and state where the land lies, and describing the boundaries on whom joining, &c.*) To have and to hold the said granted and bargained premises with the privileges, and appurtenances thereof, to him the said William Hadley, his heirs and assigns forever. And I the said William Trusty for myself, my heirs, Executors, and Administrators, do covenant with the said William Hadley, his heirs and assigns, that I am lawfully seized in fee of the premises, that they are free of all incumbrance; that I have good right to sell and convey the same to the said William Hadley to hold as aforesaid.

And that I will warrant and defend the same to the said William Hadley, his heirs and assigns forever, against the lawful claims and demands of all persons whomsoever.

In witness whereof I have hereunto set my hand and seal this tenth day of April A. D. 1814.

Signed, sealed and delivered
in presence of us William Trusty. [L. S.]
Nathan Lovejoy,
Samuel Langley.

OF MORTGAGE DEEDS.

A mortgage deed is written the same as a warranted deed, until you come to the word *whomsoever*; then the proviso, or condition of the mortgage should follow, in the following form, viz.

Provided nevertheless, that if I the said William Trusty, my heirs, executors, or administrators shall well and truly pay to the said William Hadley, his heirs, and executors, administrators or assigns, the full and just sum of —— dollars on or before the —— day of —— next (or which will be in the year of our Lord ——) with interest for the

same until paid, then this deed (as also a certain bond, or note, as the case may be, bearing even date with these presents, given by me to the said William Hadley, conditioned to pay the same sum and interest at the time aforesaid) shall be void; otherwise shall remain in full force and virtue. *In witness whereof I have, &c.*

The form of a Quitclaim Deed.

KNOW ALL MEN BY THESE PRESENTS, THAT I JOSEPH DOE of Durham, County of Strafford, and State of New-Hampshire, yeoman, in consideration of four hundred dollars to me paid by Francis Cady of Warner, County of Hillsborough, State of New-Hampshire, gentleman, the receipt whereof I do hereby acknowledge, have remissed, released, and forever quitclaimed, and do by these presents, remiss, release and forever quitclaim unto the said Francis Cady, his heirs and assigns forever, (*here the premises must be described; and the description should always point out where the land lies, on whom it is joining, the length of the lines and the point of the compass they run should be mentioned*) to have and to hold the same, together with all the privileges and appurtenances thereunto belonging, to him the said Francis Cady, his heirs and assigns forever.

In witness whereof I have hereunto set my hand and seal this tenth day of April, A. D. 1814.

Signed, sealed and delivered
in presence of us, Joseph Doe. [L. S.]
William Stebbins,
Nicholas Williams.

General form of an Agreement.

Articles of agreement made and concluded the tenth day of April, one thousand eight hundred and fourteen, by and between Thomas Smith of Dover, County of Strafford, State of New-Hampshire on one part, and Aaron Watkins, of Warren, County of Grafton, State of New-Hampshire, on the other part, *witnesseth,*

That the said Thomas Smith for the consideration of one hundred dollars worth of harness leather, to be paid by Aaron Watkins as hereafter mentioned, hath agreed, and doth hereby covenant and agree to make, or cause to be made, a good and warranted chaise with standing top, every part of which shall be made and finished in a good and workmanlike manner, together with a good plated harness well made, and every way suitable for a good chaise; which chaise and harness, the said Thomas Smith doth hereby agree to have made and ready to be delivered to said Watkins, on the sixteenth day of August next.

And the said *Aaron Watkins on his part*, doth hereby covenant and agree to pay, or cause to be paid, one hundred dollars worth of harness leather, suitably tanned and curried, on the sixteenth day of August next, delivered at Dover.

To the true and faithful performance of the several covenants and agreements aforesaid, the parties aforesaid do hereby respectively bind themselves and their respective heirs, executors, and administrators each to the other, his executors and administrators in the penal sum of —— in testimony whereof they have hereunto *interchangeably** set their hands and seals the day and year above written.

Thomas Smith. [L. S.]

Signed, sealed and delivered
in presence of us,
David Hadley,
John Hastings.

Aaron Watkins. [L. S.]

The form of a will with the devise of a real and leasehold estate.

In the name of God Amen, I A. B. of —— being weak in body, but of sound and perfect mind and memory, (*or you*

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*If the word *interchangeably* is used, each party must have a draught of the agreement, which is the proper method; and the draught that Thomas Smith has, must be signed by Aaron Watkins first: and the one which Aaron Watkins has, Thomas Smith must sign first.

may say thus, considering the uncertainty of this mortal life, and being of sound and perfect mind and memory) blessed be Almighty God for the same, do make and publish this my last will and testament, in manner and form following, viz.

First, I give and bequeath unto my beloved wife T. B. the sum of —— dollars; I do also give and bequeath unto my eldest son H. B. the sum of —— dollars; I do also give and bequeath unto my two younger sons J. B. and F. B. the sum of —— dollars apiece; I also give and bequeath unto my daughter in law S. H. single woman the sum of —— dollars; which said several legacies or sums of money I will and order shall be paid the said respective legatees, within six months after my decease. I further give and bequeath to my said eldest son H. B. his heirs and assigns, *all* that my messuage or tenement, situate, lying and being in ——, together with all my other freehold estate whatsoever; to hold to him the said H. B. his heirs and assigns forever. And I hereby give and bequeath to my said younger sons J. B. and F. B. all my leasehold estate of and in all those messuages or tenements, with the appurtenances, situate in ——, equally to be divided between them. And lastly, as to all the rest, residue and remainder of my personal estate, goods and chattels, of what kind and nature soever, I give and bequeath the same to my said beloved wife T. B. whom I hereby appoint sole executrix of this my last will and testament; hereby revoking all former wills by me made. *In witness* whereof I have hereunto set my hand and seal the —— day of —— in the year of our Lord ——.

Signed, sealed, published and declared by the above named A. B. to be his last will and testament, in the presence of us, who have hereunto subscribed our names as witnesses, in the presence of the testator. A. B. [L. S.]

Samuel Trusty,
William Sutton.

The form of an indenture to bind an apprentice, to learn a trade till twenty one.

This indenture witnesseth, that J. B. of Dover, in the County of Strafford, State of New-Hampshire, hath put and placed, and by these presents doth put and bind out his son D. B.; and the said D. B. doth hereby put, place and bind out himself, as an apprentice to A. D. to learn the art, trade or mystery of printing, the said D. B. after the manner of an apprentice, to dwell with and serve the said A. D. seven years, which will be in the year of our Lord one thousand eight hundred and twenty-one, at which time the said apprentice, if he shall be living, will be twenty-one years of age; during all which time or term, the said apprentice his said master well and faithfully shall serve; his secrets keep; his lawful commands every where at all times readily obey; he shall do no damage to his said master, nor wilfully suffer any to be done by others; and if any to his knowledge be intended, he shall give his master seasonable notice thereof. He shall not waste the goods of his said master, nor lend them unlawfully to any; at cards, dice or any other unlawful game he shall not play; fornication he shall not commit, nor matrimony contract during the said term; taverns, ale houses, or places of gaming he shall not haunt or frequent; from the service of his said master he shall not absent himself; but in all things and at all times he shall carry and behave himself as a good and faithful apprentice ought, during the whole time or term aforesaid.

And the said A. D. on his part, doth hereby promise covenant and agree to teach and instruct the said apprentice, or cause him to be taught and instructed in the art trade or calling of a printer by the best way or means he can, and also to teach and instruct the said apprentice, or cause him to be taught and instructed, to read and write, and cypher as far as the Rule of Three, if the said apprentice be capable to learn; and shall well and faithfully find and provide for the said apprentice, good and suffi-

cient meat, drink, cloathing, lodging, and other necessaries fit and convenient for such an apprentice, during the term aforesaid, and at the expiration thereof, shall give unto the said apprentice, two suits of wearing apparel, one suitable for the Lord's days, and the other for working days.

In testimony whereof, the parties have hereunto interchangeably set their hands and seals this first day of April in the year of our Lord one thousand eight hundred and fourteen.

Signed, sealed and delivered in presence of us witnesses,
William Rolly,
Ichabod Mace.

A. D. (SEAL.)
J. B. (SEAL.)
D. B. (SEAL.)

An indenture for binding out a poor child, by the overseers of the poor.

This indenture witnesseth, that B. F., W. P. and S. W. overseers of the poor of the town of ——, in the county of ——, by the virtue of a law of the State of ——, in such cases made and provided, have placed and by these presents do place and bind out as an apprentice, a poor child named ——, son of ——, of said town of ——, who is lawfully settled in and become chargeable to said town, and who is thought by said overseers to be unable to maintain him, unto —— to learn, &c. (*here proceed as in the first form until you come to the words "working days"*) and such other instructions, benefit and allowance, either within or at the end of the term, as the overseers may see fit and reasonable.

In testimony whereof the said parties have hereunto interchangeably set their hands and seals the —— day of —— A. D. ——.

Signed, sealed and delivered in presence of us witnesses,
Walter King,
Oliver Ray.

B. F. (SEAL.)
W. P. (SEAL.)
S. W. (SEAL.)

A short form of a lease from one to another.

This indenture made the eighth day of April, A. D. one thousand eight hundred and fourteen, by and between S. B. of Poplin, county of Rockingham, State of New-Hampshire, on one part, and W. P. of the same Poplin, on the other part, *witnesseth*, that the said S. B. for the consideration hereafter mentioned, hath demised, granted, and farm letten, and doth hereby demise, grant and to farm let unto the said W. P. his heirs and assigns a certain three story dwelling-house, situate in the same Poplin, known by the name of the Poplin Hotel, with all the privileges and appurtenances thereunto belonging; to have and to hold the said demised premises with their appurtenances for and during the term of six years from the date hereof, *then* to be complete and ended.

And the said W. P. for himself, his heirs, executors and administrators, doth covenant and agree to pay or cause to be paid in quarterly payments, two hundred dollars yearly, and at the expiration of the six years, peaceably to yield and release all claim in and to said premises.

In witness whereof, the parties have hereunto interchangeably set their hands and seals, the day and year above written.

Signed, sealed and delivered S. B. (SEAL.)
in presence of us, W. P. (SEAL.)
Ichabod Chase,
John Lingan.

OF RETURNS ON WRITS, &c.

A return to be made upon a writ of attachment.

Brentwood, April 12, 1814.

Pursuant to the within writ I have attached a —— the property of the within named A. B. value —— and left a summons at his dwelling house, or place of

his last and usual abode (*or if you give the summons to him, say,* and delivered him a summons) according to law.
H. C. K. *Constable.*

Fees.	9 miles travel	·54
"	service	·23
		$0·77

Return to be made upon a special writ.

Brentwood, April 13, 1814.

Pursuant to the within precept I have taken the body of the within named A. B. and taken C. D. bail for his appearance at court, as within mentioned (*if the prisoner is committed to jail the return should read thus,*) and have committed him to gaol in ——— that he may be holden for his appearance as within mentioned.

H. C. K. *Constable.*

Fees.	10 miles travel	·60
"	service	·23
		$0·83

A return to be made upon a warrant.

Brentwood, April 12, 1814.

Pursuant to the within warrant, I have apprehended the body of the within named B. W. and have him before S. T. esquire, one of the Justices of the peace for said county, for the purpose within mentioned. I have also summoned the within named C. D. and E. F. to appear as witnesses.

S. D, *Constable.*

Fees.

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Anthony Langford